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THE SUPPLY AND DISTRIBUTION OF DATES

By Billy J. Peightal
Manager, Date Administrative Committee

One of the factors essential to the Committee is the knowledge of the marketable supply of dates, the manner in which the supply is distributed between sales outlets, and the quantities of dates carried over at the end of a crop year. Such information portrays basic problems. This enables plans to be developed to cope with these problems—it permits the formulation of sound marketing policy. This information, too, is valuable to growers, for it gives them an awareness of the broad economic conditions under which their dates are marketed. It is only with an understanding of these conditions that an intelligent appraisal of programs and policies can be made.

Before proceeding further, an explanation of the terms which will be used in the discussion is deemed appropriate. First, the data in any one year relates only to the marketable portion of the total Deglet, Khadrawy, and Zahidi production; the substandard and cull portions have been deducted. The quantities are in terms of equivalent whole dates derived through the use of conversion factors applicable to pitted dates and date products. "Carryin" refers to the quantity of marketable dates, both "free" and "restricted," held by handlers together with date products and any "restricted" dates held by manufacturers of date products on August 1. "Handler receipts" means the quantity of marketable dates received by handlers from growers during the crop year. "Free dates" means those whole or pitted marketable dates sold, or which will be sold, to the trade for ultimate sale at the retail level. "Date products" are any of the manufactured forms of marketable dates. "Restricted dates" means those marketable dates which may not be sold as "free" dates but which have been, or will be, converted into date products. "Carryout" refers to the marketable dates and date products held by handlers and manufacturers at the end of a crop year—July 31.

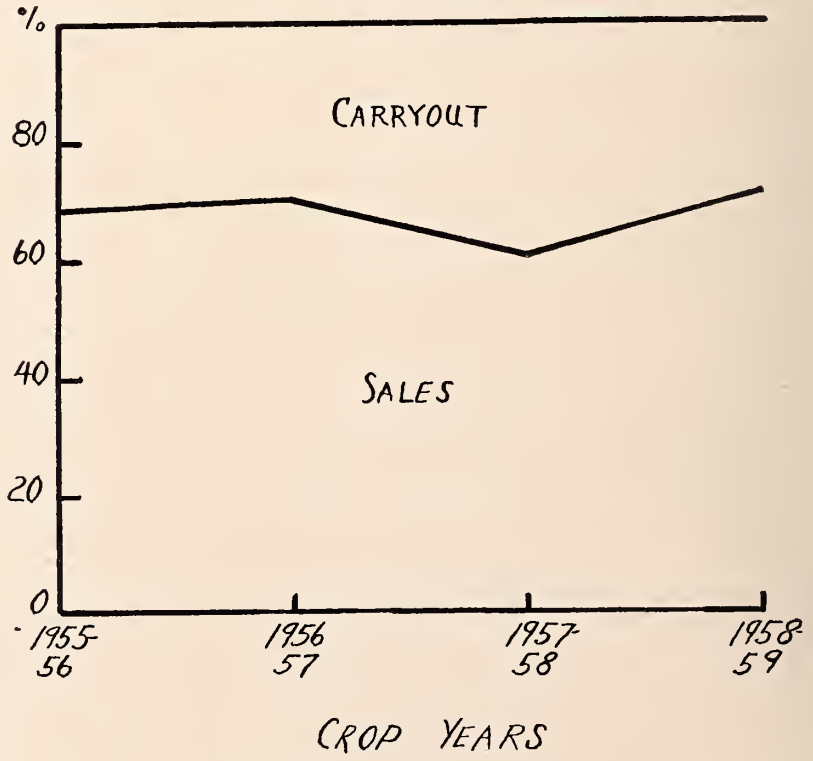
The supply of marketable dates in any given year is dependent both upon carryin and handler receipts. It should be noted (Table 1) that the maximum variation in the total supply of dates was 4.9 million pounds, while production or handler receipts during the same period has varied as much as 9.2 million pounds. This indicates a degree of sucess in the Committee's policy of balancing year to year supplies so as to minimize the impact of production variations on sales which has tended to inject strengthening in date marketing. This also indicates that relative to marketing, the production of one year cannot be separated from the production of the previous year nor the production of succeeding years, inasmuch as all are related in comprising marketable supply.

Total sales of dates show an unmistakable upward trend. This trend is apparent both in the sales of free dates and of date products, although the percentage increase in date product sales is considerably greater than free dates. Fluctuations have occurred in free date sales, which is to be expected, although the sales of date products has shown a continuous growth on the average of one-half million pounds a year. This indicates user satisfaction with date products together with new interest

Table 1. Marketable Dates: Supply, Sales and Carryout, Crop Years 1955/56—1957/58 and Estimated 1958/59

	Crop Years Beginning August 1			
	1955	1956	1957	Est. 1958
	—mil. lbs. equiv. whole dates—			
Supply				
Carryin	2.2	13.0	13.5	19.7
Handler Receipts	39.1	32.2	36.8	27.6
Total	41.3	45.2	50.3	47.3
Sales				
Free Dates	23.2	25.5	24.2	26.8
Date Products	5.1	6.2	6.4	7.0
Total	28.3	31.7	30.6	33.8
Carryout				
Free Dates	10.0	4.2	6.8	5.1
Restricted Dates & Products	3.0	9.3	12.9	8.4
Total	13.0	13.5	19.7	13.5

FIGURE 1- SALES AND CARRYOUT AS PERCENT OF MARKETABLE SUPPLY



materializing each year. Increasing date product sales simply means new business, new customers, and an expanding market—a net increase to total sales.

With the exception of the 1957-58 crop year, the carryout has varied between 13 million and 13.5 million pounds. The carryout of 1957 was 19.7 million pounds, an increase over the preceding year of 6.2 million pounds. Except for the first year in which the Order was initiated, 1955, the largest portion of the carryout was in the form of restricted dates or in the form of date products. This, again, is an indication of a degree of success of the Committee's program, for minimizing the carryout of free dates has in turn minimized the pressure the following year to dump dates regardless of price. This has led to a strengthening of marketing practices which has resulted in greater trade confidence. As this confidence increases, it will mean better returns together with an expanded free date market.

Figure 1. graphically presents the information of Table 1 in terms of percentages, with sales and carryout expressed relative to the total marketable supply. Incidentally, this information is available only for the years under consideration. It is seen that of the total supply of dates available in any one year, the quantity of dates sold beginning with the 1955-56 crop year, amounted to 68.5 percent, 70.1 percent, 60.8 percent, respectively, and 71.5 percent estimated for the 1958-59 crop year.

A PROBLEM

In view of the supply and distribution pattern which has existed, the question is whether there is need for a better relationship between supply, sales and carryout. A simple analysis of the information seems to indicate that excesses of marketable dates existed in each of the years under consideration. Therefore, without these excesses there would be a better relationship.

The method used in arriving at this conclusion leaves much to be desired, but is believed that other methods of analysis would lead to the same general conclusion. The analysis is based primarily on three assumptions:

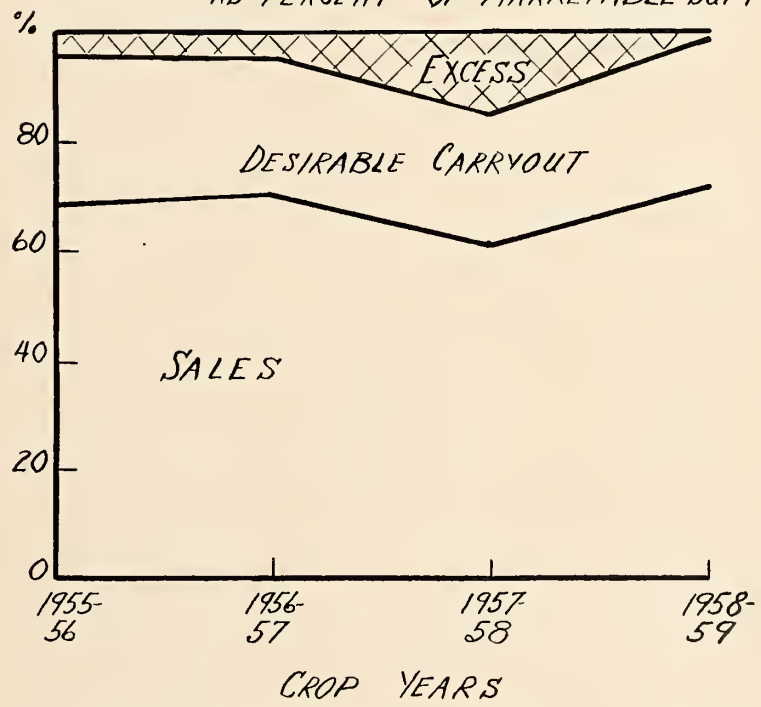
1. There is need each year for a carryout of "free" dates to satisfy the demand of the following year existing before new crop is available and a carryout of date products to assure a continuous supply of products to users;

2. The necessary carryout of "free" dates is 5.1 million pounds which approximates shipments from August 1 through mid-October; and

Table 2. Marketable Dates: Calculated Excess Quantities Crop Years 1955/56—1957/58 and Estimated 1958/59

	Crop Years Beginning August 1			
	1955	1956	1957	Est. 1958
	—mil. lbs. equiv. whole dates—			
Supply				
Carryin	2.2	13.0	13.5	19.7
Handler Receipts	39.1	32.2	36.8	27.6
Total	41.3	45.2	50.3	47.3
Sales				
Free Dates	23.2	25.5	24.2	26.8
Date Products	5.1	6.2	6.4	7.0
Total	28.3	31.7	30.6	33.8
Carryout				
Free Dates	10.0	4.2	6.8	5.1
Restricted Dates & Products	3.0	9.3	12.9	8.4
Total	13.0	13.5	19.7	13.5
Desirable Carryout				
Free Dates	5.1	5.1	5.1	5.1
Restricted Dates & Products	6.2	6.4	7.0	7.5
Total	11.3	11.5	12.1	12.6
Excess	1.7	2.0	7.6	.9

FIGURE 2- CALCULATED EXCESS QUANTITIES AS PERCENT OF MARKETABLE SUPPLY



3. The carryout of date products should be sufficient to equal the product sales of the following year. This level is believed actually to be higher than requirements. It is used arbitrarily for the purpose of this analysis.

The assumptions noted above are incorporated in Table 2 under the term "Desirable Carryout." Differences, then, between desirable carryout and actual carryout constitutes the excess of marketable dates which seems to have existed in each of the years reviewed. The excess amounted to 1.7 million pounds in the 1955-56 crop year, and 2.0 million pounds and 7.6 million pounds, respectively, in each of the two succeeding years. An excess of .9 million pounds estimated for this crop year is the least amount which has existed. As a percent of the total marketable supply (Figure 2), the excess has amounted to 4.1 percent, 4.5 percent, 15.1 percent, and 1.9 percent, respectively, in each of the crop years.

The analysis then indicates a basic problem—the need to improve the relationship between supply, sales and carryout.

AN OBJECTIVE

Knowing the problem permits the formulation of an objective, an objective which has been at the heart of all Committee decisions; namely, aiding the expansion of sales of both "free" dates and date products.

The means by which the Committee through the Order has aided, encouraged, and in fact, expanded sales are several. Relative to "free" dates, minimum quality requirements have been established in order to create consumer confidence in the quality of California dates. There is no doubt that confidence in the quality of purchases will lead to expanded sales.

The very act of establishing the requirements for orderly marketing has created a condition conducive to an expansion of "free" dates sales. Thus by limiting the quantity of "free" dates available for sale in any given year to the estimated trade demand through the establishment of the free and restricted percentages, erratic behavior causing price declines unwarranted by supply and demand conditions has been lessened. This in turn has resulted in greater confidence in the industry by the trade which in time definitely will lead to an expansion of "free" date sales.

In consideration of this matter of expanded "free" dates sales, it must be pointed out that large increases will be realized mainly through changes in consumer purchasing habits, the establishment of new outlets such as the export market, or through population growth. These all are long term prospects. This can be no deterrent to continued efforts to expand sales, however, for the "free" date outlet compared with the outlet for date products is by far the most important both in terms of quantity and unit value.

Because it is realized that the expansion of "free" date sales is a long term process, the Committee has sought to expand total sales in a relatively shorter period of time by encouraging both the development and sales of date products. It is obvious that consumers are buying more food items in convenience form, either fully prepared for use or partially prepared. Products which lend themselves to such preparations, therefore, are finding new and expanding outlets. Since dates in product form readily can be incorporated into such preparations, the opportunity exists for increasing sales through such outlets in a shorter period of time than is required for "free" dates marketed in established outlets. The relative increase in the sales of date products compared with "free" date sales substantiates this.

A basic part of the industry's date products program has been the activities of the Committee. Providing "restricted" dates for the raw material not only has encouraged the development of date products, it has encouraged the use of these products by food processing firms through assuring quantities sufficient to constitute a continuous supply. The Committee's research activities has resulted in new products being developed and improvements in those previously manufactured. Further, the diversion programs successfully obtained directly has aided growers during the transition to this enlarged concept of marketing dates, it has aided in the acquisition of equipment to manufacture products, and it has aided in all phases of development, promotion and sales of these products.

In conclusion, it would seem that increased sales of both "free" dates and date products are necessary for a better relationship between the supply and distribution of dates. Increased "free" date sales is a long term process while increased sales of date products offers the best possibility for expansion in a shorter period of time. All of the Committee's actions basically have been directed toward aiding the industry in expanding sales.

EFFECTS OF GIBBERELLIN ON FRUITSTALKS AND FRUIT OF DATE PALM

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INTRODUCTION

Anyone scanning the horticultural literature of the last two years will be impressed by the number of papers dealing with the effects of gibberellin on many kinds of plants. Spectacular results have been obtained in some instances. Most commonly vegetative growth has been stimulated so that increases in the length of stems and the height of plants are pronounced. Earlier than normal flowering and improved fruit set have been reported. In a few instances seedless (unpollinated) fruit has been produced and in some cases size and shape of the fruit changed. Other effects continue to be reported from time to time (1).

This growth regulator that is causing so much excitement in the horticultural world was discovered in Japan during study of a disease of rice caused by the fungus *Gibberella fujikuroi*. A characteristic symptom of the disease is abnormal elongation of the rice stem. From cultures of the fungus was obtained a filtrate that produced similar elongation in the absence of the fungus. From subsequent study these striking effects were traced to several closely related chemical substances grouped under the name, gibberellin, of which gibberellic acid and potassium gibberellate are the best known.

Although many kinds of plants have been found to be affected in various ways by gibberellin, it has not been possible to predict just how a particular species or variety would respond. Exploratory experiments were begun in 1958 to find out what gibberellin would do to dates. Several possibilities were considered. A good seedless date, approaching the pollinated one in quality, would be highly desirable. Increase in size and change in time of ripening without sacrifice of quality might be beneficial under some conditions. The fruitstalks of some varieties are too short, thick and stiff to permit proper handling of the bunches; this is particularly true of the late bunches of the Medjool variety.

MATERIALS AND METHODS

Gibberellin was applied to fruitstalks, flowers and fruit at different periods in their development. Gibberellic acid was used in the early part of the season and potassium gibberellate later. Concentrations of 10 to 1000 ppm in aqueous solutions except for a few comparative tests with 95% ethyl alcohol were sprayed on the flowers and fruit and a concentration of 1% in lanolin was applied with a small brush. "Tween 20" at the rate of about 1 cc to 1 liter was used as a wetting agent.

Applications to immature, unopened inflorescences were made by cutting off the tip of the spathe when it was only 4 to 6 inches above the fiber line and scooping out the strand tips enough to make a cup-shaped depression about 3-4 cc in volume. This depression was filled with the aqueous solution (10 to 1000 ppm), which slowly disappeared, and the process was repeated until about 20 cc of liquid had been applied.

Applications to fruitstalks were made by pouring about 50 cc of 1000 ppm aqueous solution around the base within the spathe after opening. A few applications to fruitstalks were made by injecting aqueous solutions of 1000 ppm with a rubber bulb through a hole drilled through the base of the leaf at, or a little below, the fiber line and directed toward the approximate point of connection between fruitstalk and trunk.

All tests planned for the fruitstalks were on the Medjool variety. Treated fruitstalks were paired with untreated ones of approximately the same age and therefore likely to be of about the same size. The Deglet Noor and Medjool varieties were used for most of the applications of gibberellin to flowers and fruit, but a few tests were made on Halawy, Khadrawy and Barhee.

Except in experiments in which applications were made to the fruitstalks or the inflorescences before the opening of the spathes, the different treatments were applied to different strands on the same bunch. Observations were made at monthly intervals or oftener throughout the season. At maturity all the fruit and 30 seeds (all if less than 30) were weighed and 10 fruits and seeds selected at random from each treatment were measured for length and breadth. Because of the large number of different exploratory treatments the number of replications of any one treatment was not sufficient for determination of statistical sig-

Figure 1. *Curvature and spiralling of Medjool fruitstalks resulting from applications of gibberellin.*

[1]*The author is indebted to Eli Lilly and Co., Merck and Co., and the Chas. Pfizer Co. for supplying gibberellins for these experiments.*

Table 1. Effect of gibberellin applied to immature unopened inflorescences on fruitstalks of Medjool dates.[1]

Experiment No.	Gibberellin applied (mg)	Length to base of 1st strand (cm)	Length from base of 1st strand to most distal tip (cm)	Breadth immediately below strands (mm)	Thickness immediately below strands (mm)
1.	0 (Control)	93	69	76	18
	0.2	129	83	65	18
2.	0 (Control)	118	72	73	16
	10	160	67	54	13
3.	0 (Control)	130	96	70	18
	20	186	86	57	14

[1]Data from measurements of individual fruitstalks in each treatment.

nificance except for the early applications to pollinated Deglet Noor fruit.

RESULTS

Fruitstalks

The application of gibberellin increased the normal curvature of the fruitstalks but also resulted in so much spiral twisting that there was a complete turn of 360° in several instances (Fig. 1). There was an increase in the length of fruitstalks, but it was not always apparent because of the spiral form. This increase was usually accompanied by a decrease in width (Table 1).

Similar effects on the fruitstalks were produced by gibberellin applied in any way to the fruitstalks themselves or the flowers up to and including the period of receptivity to pollen (the week or 10 days after the opening of the spathe).

Unpollinated fruit

A female date inflorescence which receives no pollen normally develops some parthenocarpic, or seedless, fruit. When pollinated, only 1 of the 3 carpels of a date flower develops, but when unpollinated, 1 or 3 carpels may develop; differences in this respect are apparently largely a matter of variety. Fruit without seed is usually smaller and narrower than fruit with seed, and when 3 carpels develop each is smaller than 1 that develops by itself.

Aqueous sprays of gibberellin applied to unpollinated Deglet Noor flowers within a few days of the opening of the spathe stimulated the development of all three carpels in a large proportion of the flowers instead of the single carpel that normally develops in this variety either with or without pollination. But only single carpels developed when gibberellin in ethyl alcohol was applied 5 weeks later to two Deglet Noor inflorescences in the same stage of development, even though the effects of the growth regulator were evident later in the lengthening and twisting of the fruitstalks. In some instances the 3 carpels that developed from one Deglet Noor flower shriveled before reaching full development, but a large proportion of them attained a size almost equal to that of the single unpollinated carpels, but they differed in shape. Multicarpel development did not occur in the Medjool variety, in which single seedless carpels develop somewhat as in Deglet Noor. In the Barhee, Halawy, and Khadrawy varieties, the development of all 3 carpels of unpollinated flowers is common, but when gibberellin was applied during the period of receptivity to pollen, a large percentage of single seedless carpels developed.

No multicarpel development resulted from application of gibberellin to unpollinated flowers more than a week or 10 days after the opening of the spathe, but the elongation of single carpels during the early period of fruit growth was obviously accelerated by single applications of concentrations of 500 ppm or more. When mature, this fruit was usually narrower than untreated fruit, but the length was variable except that in the Deglet Noor variety the upper range of concentrations seemed to produce fruit that was consistently longer (Table 2).

Unpollinated dates are much later in ripening than pollinated ones, and some of them never reach normal maturity. When gibberellin was applied within a few weeks after the opening of the spathe the effect on the ripening of unpollinated dates was not pronounced, but some of the fruit of the Deglet Noor variety did not acquire as much pink khalal color as untreated dates and tended to shrivel or soften sooner. Unpollinated Deglet Noor fruit treated when about 2 months old and about ½ inch long, in the early stage of rapid growth, acquired still less pink khalal color; instead much of it retained a greenish cast and began to shrivel at the tip before normal ripening. In two such experiments, examined on February 24, 1959, there were still many dates that retained some of the hard texture and pink color characteristic of the khalal stage, but there were about twice as many dates of this type in the untreated lots as in the lots sprayed with 1000 and 500 ppm of gibberellin. In short, in these two experiments gibberellin hastened ripening, albeit somewhat abnormally.

Pollinated fruit

One application of gibberellin to the flowers or young fruits within 3 or 4 weeks after pollination also accelerated elongation of the fruit during the early part of its period of rapid growth. The effect could be observed 4 or 5 weeks after treatment. The lengths of both fruit and seed of mature Deglet Noor dates were increased as the concentrations of gibberellin were increased (Table 3). Breadth of fruit was increased by concentrations of 10 and 100 ppm and decreased by a concentration of 1000 ppm. Breadth of seed was not affected by a concentration of 10 ppm but was reduced by higher concentrations. There was little effect on fresh weight of either fruit or seed.[2] The results indicate that in both fruit and seed of Deglet Noor dates gibberellin in the higher concentrations used produced an increase in length at the expense of breadth.

Applications of different concentrations of gibberellin to varieties other than Deglet Noor failed to produced any consistent differences in the length of ripe fruit. However, the breadth and weight of treated fruit were consistently less than that of untreated fruit, but there were not

[2]*The data summarized in Table* 3 *provided enough replications for statistical analysis, for which credit is due to E. J. Koch of the Biometrical Services, Agricultural Research Service, U. S. Department of Agriculture, Beltsville, Maryland. The Duncan Multiple Range Test was applied to means. Increases in lengths of fruit and seed were significant at the* 1% *level for concentrations of gibberellin above* 10 *ppm but as between consecutive concentrations only between* 10 *and* 100 *ppm. The differences mentioned in breadths of fruit and seed were significant at the* 5% *level.*

Table 2. Effect of gibberellin on size of unpollinated Deglet Noor fruit.[1]

Concentration of gibberellin (ppm)	0	10	100	500	1000	10,000
Length (mm)	47.4	48.0	47.2	49.1	49.2	51.7[2]
Breadth (mm)	17.8	17.4	17.0	16.6	16.7	16.5[2]

[1]Figures are averages of four experiments except as noted. Applications were made in aqueous sprays except for the highest concentration which was in lanolin paste.
[2]Average of two experiments.

Table 3. Effect of gibberellin sprays on size of pollinated Deglet Noor fruit and seed.[1]

Concentration of gibberellin (ppm)	0	10	100	500	1000
			Fruit		
Length (mm)	44.6	45.2	46.6	47.1	47.5
Breadth (mm)	20.9	22.1	21.4	21.0	19.9
Fresh weight (gm)	10.9	11.1	11.2	11.0	10.6
			Seed		
Length (mm)	24.9	25.4	26.7	27.6	28.4
Breadth (mm)	7.1	7.1	6.7	6.7	6.6
Fresh weight (gm)	.71	.72	.71	.70	.76

[1]Figures are averages of six experiments.

enough replication to determine significance. The seed of varieties other than Deglet Noor showed a tendency to be longer and narrower when applications of gibberellin were in the upper range of concentrations, but there was no effect on fresh weight.

In several experiments 1% gibberellin was applied in lanolin paste to the tips of flowers or small fruit. The effects seemed to be slightly more pronounced than those of the highest concentration of spray, 1000 ppm.

In a few experiments single applications of 10 and 500 ppm of gibberellin were repeated 2 or 3 times at intervals of 2 or 3 weeks. Such repetitions seemed to accentuate slightly the effects noted, but not enough to exceed those of one application of a higher concentration, 1000 or 10,000 ppm. From tests made at different times during the season it appeared that applications of gibberellin within 3 or 4 weeks after pollination had more effect on size of fruit than those made later.

The effect on ripening of gibberellin applied to fruit within a few weeks after pollination was not pronounced. In some instances the maturity of Deglet Noor fruit appeared to be hastened a little, but this earlier ripening was somewhat abnormal because of the tendency, already noted, for fruit to shrivel prematurely as concentrations of gibberellin were increased. On the other hand, later applications of gibberellin had more definite effect on time of ripening. The acquisition of khalal color was partially inhibited and a slight delay in maturity resulted from applications of 500 and 1000 ppm of gibberellin to Deglet Noor and Medjool fruit on June 30 and to Barhee fruit on May 28.

Gibberellin appeared to increase the susceptibility of Deglet Noor dates, not only to shrivel as previously mentioned, but also to checking and blacknose (Table 4). There was very little checking and blacknose in Coachella Valley in 1958, and only a small amount occurred in a few of these experiments, but the evidence that it was increased following the application of gibberellin is important as an indication of what might happen under less favorable conditions.

Table 4. Effect of gibberellin on checking and blacknose of Deglet Noor dates.[1]

Concentration of gibberellin (ppm)	Checking (percent)	Blacknose (percent)
0	2	0
10	4	1
100	11	1
500	14	6
1000	10	2
10000	11	11

[1]Four experiments combined. Applied in sprays except for the highest concentration, which was in lanolin paste.

SUMMARY

Single applications of gibberellin, made in different ways with varying amounts of solutions at concentrations of 10 to 1000 ppm, to inflorescences or fruitstalks of the date palm at any time up to and including the pollination period increased the length of the fruitstalk, but also produced undesirable spiralling.

Gibberellin was applied to date fruit in sprays at concentrations of 10 to 1000 ppm and in lanolin paste at a concentration of 1%. Single applications to unpollinated or pollinated fruit within a few weeks after the opening of the spathe accelerated elongation during the early period of its growth. At time of ripening treated fruit was longer than untreated fruit of the Deglet Noor variety, but the effect on length of other varieties was variable. The breadth of treated fruit was less than that of untreated fruit except in the Deglet Noor variety at the lower range of concentrations. Applications of gibberellin within a few weeks after the opening of the spathe had more effect on size of fruit than those made later.

There was little effect on the time of ripening of unpollinated or pollinated dates of gibberellin applied to the fruit within a few weeks after the opening of the spathe. There was a tendency for the treated fruit of the Deglet Noor variety to shrivel prior to ripening, especially noticeable at the higher concentrations, and in some instances this gave a final appearance of slightly earlier ripening. Gibberellin increased the susceptibility of Deglet Noor fruit to checking and blacknose.

Gibberellin applied to the fruit when it was about half size had more effect on coloring and ripening than that applied earlier. Fruit treated at this stage never acquired a pronounced khalal color. Unpollinated Deglet Noor fruit treated when half-grown ripened earlier than untrcated fruit, but the behavior of the former was somewhat abnormal because of premature shrivel. Pollinated fruit treated when half-grown ripened slightly later than untreated fruit of the Deglet Noor, Medjool and Barhee varieties.

The results of these experiments do not suggest any benefit from the application of gibberellin to date fruit. It seems possible, however, that by varying the dosages or method of application short fruitstalks might be lengthened without undesirable twisting.

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PROGRESS OF CHEMICAL STUDIES OF DEGLET NOOR DATES

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The chemical deterioration of domestic Deglet Noor dates is a serious obstacle to the complete utilization of the annual crop. Insect infestation and microbial spoilage may be controlled through the use of fumigants, but chemical changes proceed unchecked. Refrigeration and freezing are useful in retarding deterioration, however, these methods do not offer lasting protection during the subsequent period when dates are exposed to room temperature (11). There is, therefore, need for a practical method of processing which will stabilize dates against all types of spoilage.

A specific knowledge of the chemical mechanisms responsible for the deterioration of dates is essential to the development of a method of preservation. It is well known from the work of others (8, 11, 12) that pronounced chemical and physical changes are associated with deterioration in dates. These include an increase in darkness, softness and sirupiness, and a decrease in pH, aroma and flavor. Unfortunately, little is known of the chemical mechanisms responsible for these changes and methods for their prevention are not available. In addition, there are many gaps in the knowledge of the detailed chemical composition of dates.

This paper reports the present status of rate studies of deteriorative changes which occur in date tissue, and briefly outlines the results of preliminary work on the isolation and identification of date polyphenols. Since this paper is a progress report, full experimental details are not included. When the work has been completed it will be published in its entirety.

EXPERIMENTAL

Choice natural dates, 1957 crop, 19.1% moisture content, were used throughout this study. They were color graded and thoroughly randomized to insure sample uniformity. Approximately 25 dates (275 gm.) were weighed into glass jars. Two series of 7 jars each were used as untreated controls. In addition, the following treatments were carried out on 6 series each consisting of 7 jars: (1) 3 series were gassed with nitrogen following the removal of air; (2) 2 series were gassed with nitrogen, then heated, one for 25 minutes at 194° F. (short-heat) and the other for 45 minutes (long-heat), then regassed with air, and (3) one series was treated with 0.5 ml. per jar of a commercially used preservative (85% methyl formate, 15% ethylene oxide) prior to sealing. All jars were hermetically sealed and held at 120° F. to accelerate deterioration.

At various time intervals up to 618 hours, one jar from each of the 8 series was removed and analyzed. The headspace gas of each jar was analyzed for carbon dioxide and oxygen using a paramagnetic oxygen analyzer. The dates were then pitted, ground and the following analyses performed on the paste: darkness by reflectance (7), soluble dark pigment content (7), acidity (pH) (11), and invert and total sugars (3). Polyphenolase activity was determined by the method of Rashid (9).

RESULTS AND DISCUSSION

Reflectance: The effects of the various treatments on the rate of decrease in reflectance with respect to the controls are summarized in Table 1 (A). Previous work has shown that reflectance determined in this manner is closely related to the visually observed darkness of whole dates (7). In absolute terms the control dates changed from an initial reflectance value of 16.8% to a final value of 4.35% after 600 hours at 120° F. From these results it appears that darkening under these conditions may be caused by two different systems. At this temperature the primary system is nonoxidative and nonenzymic. This is demonstrated by the failure of the nitrogen atmosphere and heat treatments to prevent the darkening. The secondary system leading to darkening is oxidative and enzymic. This is shown by the 20% reduction in the rate of darkening in the absence of oxygen. The 6.5% reduction in the rate exhibited by the short-heat sample is in qualitative agreement with the partial inactivation (22%) of polyphenolase (a darkening enzyme) due to the heat treatment. The failure of the long-heat dates, in which the enzyme activity was zero, to show a reduction in the darkening rate is undoubtedly caused by the initial darkening due to the heat treatment. Inactivation of polyphenolase by means of heat treatment was accompanied by considerable darkening. The 15% reduction in the darkening rate of preservative-treated dates is probably caused by their lower pH (see below). Tests in which acetic acid was used to lower the pH of dates indicated that the rate of darkening was lower in the treated fruit.[3] The commercial application of this treatment will be investigated.

Soluble dark pigment: Soluble dark pigment formation is another measure of the darkening process in dates (7). The control dates initially contained 5.0 mg. pigment/g. dry tissue and 30.8 mg/g. after 600 hours at 120° F. The data in Table 1 (B) summarize the effect of the various treatments on the rate of dark pigment formation relative to the control rate. These results are in general agreement with the reflectance results and further support the proposition that the major darkening system under these conditions is nonoxidative and nonenzymic. The 11-15% reduction in the darkening rate due to nitrogen or heat treatments again indicated the presence of a secondary oxidative, enzymic darkening system. In the case of the preservative treatment, dark pigment formation is more rapid than in the control. This could be due to an indirect effect of the preservative on the tissue resulting in greater extractability of the pigment or to a direct effect causing an acceleration of pigment production. In view of the reflectance results the first explanation seems to be more logical.

Since dates contain amino acids (10) and reducing sugars the nonoxidative, nonenzymic darkening is probably due to carbonyl-amine browning. The oxidative enzymic darkening is most likely the result of polyphenolase activity.

Acidity (pH): After 600 hours at 120° F. the pH of date tissue held in the presence of air changed from its initial value of pH 6.0 to a final

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[1] *Collaborator employed by Date Administrative Committee, Indio, California, with whom this work was conducted cooperatively.*

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[3] *Individual manufacturers should consult the Food and Drug Administration, Washington* 25, *D.C., and the food and drug officials of the individual states involved, to determine if the use of any proposed additive is permissible, and if so, what limitations are placed on its use.*

Table 1. Relative rates of deteriorative changes occurring in dates at 120° F. as affected by various treatments.

	Relative rates as percent of control rate					
	A	B	C	D	E	F
Treatment	Reflectance decrease	Soluble dark pigment formation	pH decrease	Sucrose inversion	Oxygen absorption	CO_2 production
Air (control)[1]	100	100	100	100	100	100
Nitrogen[2]	80.1	88.9	74.0	94.5	....	....
Short-heat	93.5	85.5	74.0	11.1	78.4	80.2
Long-heat	105	86.0	108	14.5	64.0	70.2
Preservative	85.0	115	222	116	100	71.0

[1]Averages of duplicate runs.
[2]Averages of triplicate runs.

value of 4.7. The data in Table 1 (C) summarize the effects of the several treatments on the rate of pH decrease relative to the control rate. It is clear that the primary reaction system responsible for the decrease in pH is nonoxidative and nonenzymic since neither the nitrogen nor heat treatments prevents this change. The 26% decrease in rate shown by the nitrogen and short-heat treated dates suggests the presence of a secondary oxidative, enzymic system which either directly supplements or indirectly enhances the primary nonoxidative system. A similar pattern of results is apparent between pH and reflectance indicating a relationship between the two properties. It is possible that the decrease in pH is a result of the same reaction system which causes tissue darkening. A decrease in pH during darkening has been observed in model browning systems (5).

The effect of the preservative on the rate of pH decrease is very marked. The high rate is caused by a drop of 0.5 pH unit in the first 24 hours after treatment. This rapid change is undoubtedly due to the presence of formic acid released by hydrolysis of the methyl formate in the preservative. When ethylene oxide, the other constituent of the preservative, was used by itself no significant change in pH was observed.

Total and invert sugars: On a dry-weight basis the dates had a total sugar content of 82.9%. Initially, 38.6% of this total sugar was reducing sugars, while after 600 hours at 120° F. the amount increased to 82%. Table 1 (D) shows the effects of the several treatments on the rate of sucrose inversion relative to the control. From these results it is apparent that an enzyme is responsible for the inversion of sucrose, since the heat treatments produce an 85-89% inhibition. This enzyme (14), called invertase, is much more heat sensitive than polyphenolase since it was almost completely destroyed by the short-heat treatment which only destroyed 22% of the polphenolase activity. None of the other treatments had a significant effect on the rate of inversion. Since the short-heat treatment necessary to inactivate invertase does not cause significant darkening it is possible to prevent cane-sugar dates from becoming invert-sugar types without causing a detrimental color change.

Oxygen absorption: Table 1 (E) shows the relative rates of oxygen absorption of the treated dates and untreated controls. The amount of oxygen absorbed by the control dates after 600 hours at 120° F. was 0.52 mg./g. of dry tissue. The heat treatments were sufficient to cause a 22-36% decrease in the rate of oxygen uptake. Thus, in addition to a major heat insensitive oxygen utilizing system there is present a heat sensitive enzyme system or systems. A portion of the oxygen uptake due to enzymes can be accounted for by the oxidative, enzymic portion of the darkening process. In addition, some tissue respiration could be taking place. (The heat treatment is not considered sufficient to destroy the respiratory systems in the date pit.)

The effect of the preservative on the rate of oxygen absorption, Table 1 (E), is nil. Since the preservative used is an excellent sterilizing agent, it is apparent that the oxygen absorption observed is not caused by the respiration of microorganisms. (This is also supported by the oxygen absorption of the heated dates, their low moisture content, and the absence of a fermentation odor.) In addition, these results show that oxygen uptake is not sensitive to moderate changes (0.5 units) in the pH of date tissue.

At the present time, the reaction system responsible for the major portion of the oxygen consumption by dates is unknown. Apparently it is a nonenzymic, non-darkening reaction. A minor portion could be accounted for by respiration of the pits, however, dates with the pits removed still take up considerable oxygen. It is possible that lipid autoxidation consumes considerable oxygen, since a noticeable soapy to rancid odor was noted in the headspace of the air-filled jars but was absent in the nitrogen-filled jars.

Carbon dioxide production: The data in Table 1 (F) show the effects of the treatments on the rate of carbon dioxide production as compared with the control. The amount of carbon dioxide produced by the control dates after 600 hours at 120° F. was 0.74 mg./g. dry tissue. In this case all treatments resulted in decreased rates ranging from 20 to 30%. Because of the method of gas analysis used, carbon dioxide could not be measured in the absence of oxygen and so it is not known whether carbon dioxide is produced in the absence of oxygen. The results do show that the major portion of the carbon dioxide produced is the result of a nonenzymic reaction. Small amounts of carbon dioxide are produced by the pits, however, dates with the pits removed still produce relatively large amounts of the gas. Proof of whether or not carbon dioxide is a product of the darkening reaction system will require further work. The effect of the preservative in reducing the rate of carbon dioxide production may be due to the lower pH.

PRACTICAL SIGNIFICANCE OF RESULTS

Although the study of the chemical systems responsible for the deterioration of dates is far from complete, several points of practical significance have been uncovered. The reflectance and soluble pigment studies show that the rate of darkening of low-moisture choice natural Deglet Noor dates at 120° F. may be decreased by 20% by placing them in an oxygen free atmosphere. Preliminary results of a similar study at room temperature indicate that the advantage of removing oxygen will be even greater at lower temperatures. The influence of moisture on the beneficial effect of packing dates in the absence of oxygen is presently being studied and should provide an even clearer picture of this general phenomenon.

The studies of total and reducing sugars show that cane-sugar dates can be prevented from eventually becoming invert-sugar types by a mild heat treatment which does not darken them significantly.

CHEMICAL COMPOSITION STUDIES

This portion of our research is concerned with the isolation and identification of the unknown chemical constituents of dates. It has been known for many years that dates contain appreciable amounts of polyphenols (9, 13, 14) (generally referred to as tannins); however, these substances have never been positively identified and studied. Polyphenols have been shown to have a pronounced influence on the color, texture, and taste of other fruits and vegetable (1,6). In addition, they

are known to have fungicidal activity (13), and some are thought to be enzyme inhibitors (4). In view of the many important properties of these substances further knowledge of their presence in dates is essential.

Since the polyphenols of ripe dates are present in the form of insoluble granules, it is necessary to use green (kimri stage) fruit to obtain extractable material. The polyphenols of green dates have been found to make up about 3% of the dry weight of the pitted fruit. This crude mixture of polyphenols contains at least 3 separate complex (polymeric) polyphenols which account for about 98% of the crude mixture. Treatment of the complex polyphenols with hot acid (HCl) in alcohol (isopropanol) yields a red anthocyanidin pigment which has been tentatively identified as cyanidin chloride (3, 5, 7, 3', 4'-pentahydroxyflavylium chloride). Thus, the complex polyphenols can be classified as leucocyanidins. The extreme insolubility of the complex polyphenols in common solvents indicates that they are large molecules (polymers) so that they can be further classified as polymeric leucocyanidins. Degradation with hot caustic yields the simple polyphenols phloroglucinol and protocatechuic acid, which further help to characterize the phenolic hydroxylation pattern of their basic structural unit as being identical with that of leucocyanidin.

The formation of red pigment when leucocyanidins are treated with hot acid can be used as a qualitative test for their presence (2). Using this method it was found that green dates produce an intense red colored solution; ripe dates give only a faintly red solution, but the tissue stains red; while deteriorated, darkened dates give neither a red solution nor red stained tissue. From this information it can be concluded that green dates contain considerable amounts of extractable leucocyanidins. Since the red pigment was formed attached to the tissue of ripe dates the leucocyanidins were insoluble but still retained their characteristic pigment producing property. The failure of deteriorated dates to produce a red pigment indicated that the leucocyanidins had undergone considerable chemical modification such that they no longer gave the characteristic test. It is believed that the chemical change of the leucocyanidins is at least partially responsible for the darkening of date tissue.

The remaining 2% of the crude polyphenol mixture is made up of at least 10 minor polyphenolic constituents. One of these appears to be a chlorogenic acid type substance and another to be a flavone. Turrel, Sinclair and Bliss (13) previously reported flavones in dates.

During the process of isolating the polyphenols from green dates a small amount of crystalline material was isolated from one of the extracts. This material proved to be mesoinositol, a member of the B vitamin group. On the basis of the amount of crystalline material isolated, mesoinositol was present to the extent of 0.04%, on a dry weight basis. Since this method could not be be considered quantitative, this figure serves as a minimum value only. This is the first reported isolation and identification of mesoinositol from date tissue.

SUMMARY

Darkening of low-moisture choice natural Deglet Noor dates takes place by two pathways. At 120° F. the major pathway is nonoxidative and nonenzymic while the minor one is oxidative and enzymic. The reaction system responsible for the decrease in pH is primarily nonoxidative and nonenzymic. Sucrose inversion, which is caused by invertase, can be prevented by a relatively mild heat treatment. Oxygen absorption occurs by both enzymic and nonenzymic pathways, as does the production of carbon dioxide.

On a dry-weight basis the polyphenol content of green Deglet Noor dates is about 3%, the major components being polymeric leucocyanidins. The minor components are numerous and appear to include a flavone and a chlorogenic acid type compound. In addition, mesoinositol has been found for the first time to be present in green date tissue.

ACKNOWLEDGMENTS:

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RESEARCH ON DATES AND DATE PRODUCTS

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The sale of whole and pitted dates has been relatively steady during the years 1951-7, and it is through this outlet that the grower and packer derives most of his income. This outlet utilizes up to 60-75% of the annual crop, depending upon its size. However, the problem of utilizing the remainder of the dates has plagued the industry for many years. The production of date products, a secondary outlet for the industry, has been steadily increasing since 1951, but it has not reached sufficient volume to dispose of the remainder of an average crop. Thus, in recent years the carry-over of dates has been increasing from season to season (6).

In order to bring about a more complete utilization of the domestic date crop new and improved products are needed which do not compete with the sales of whole and pitted dates. In addition, the sale of whole and pitted dates may be increased by processing modifications which may improve their quality, increase their stability, and make them more acceptable to the consumer.

This paper reports the results of research on the development of new and improved date products, methods to increase their stability, and the development of coatings for whole dates. Results of chemical studies of Deglet Noor dates are reported elsewhere in these proceedings.

DATE PRODUCTS

DATE SIRUP. An improved 65° Brix date sirup has been prepared from second grade dates. It is sparklingly clear, free flowing and has excellent color, flavor and stability. Unpasteurized, it will keep at 83° F. for well over a year with little change in color or flavor. It turned dark and acquired a caramel flavor after approximately 6 months at 100° F. In its preparation, one part of pitted, coarsely ground dates is mixed with five parts of water in a steam-jacketed kettle and heated to 140-160° F. for 1 hour with stirring. The mixture is cooled; then 0.02-0.03% of Pectinol 10-M (a pectin splitting enzyme) is added and allowed to react for approximately 12 hours. The extract is decanted, a sufficient amount of filter aid is added to form approximately a ¼" layer on the plates, and the juice is clarified by filtration. The filtering operation is fairly slow. The clarified juice is then vacuum concentrated to a 65° Brix sirup at a temperature not to exceed 140° F.

DATE NUT SPREADS. These products are combinations of finely ground dates with peanut butter, ground almonds, walnuts or peanuts. They can be used as sandwich or cracker spreads or as cake decorations and pastry fillings. At room temperature they are easily spread and have a light color and pleasant flavor. At 83° F. they were stable for a period of 6 months; however, after that time the nuts became rancid. The addition of antioxidants might improve their stability by retarding the rancidity. The spreads are prepared from 10 parts of finely ground dates (approx. 22.0% moisture), 5 parts of ground walnuts, almonds, or peanuts, 2 parts of shortening (margarine), and 1 part of water. In the case of the date-peanut butter spread, 6 parts of finely ground dates are mixed with 2 parts of peanut butter, 1 part of shortening, and ½ part of water. The ingredients can be blended to a smooth and uniform consistency.

PUFFED-DRIED DATE POWDER. This product is easily water dispersible, has a distinct date flavor and a light-brown color. It has been successfully incorporated into jelly confections, and could also be used by the baking industry where a high quality, water dispersible date powder is an essential requirement. This date product was prepared by the puff-drying process used in the preparation of orange juice powder by Strashun and Talburt (7).

In this process ground dates are blended with 1½ parts of water, the resulting puree spread in a thin film on metal pans and dried in a vacuum chamber at 140° F. and 10 mm. pressure or less for 15 hours. The puree expands into a sponge-like consistency during drying. After cooling the sponge brittle is readily removed from the pans and ground to a powder (moisture content 2.0-4.0%). The powder is highly hygroscopic and care must be taken during this stage to prevent excessive lumping. For the same reason, moisture-proof packaging material must be used for the finished product.

DEHYDRATED PITTED DATES. In response to a request from the date industry, more rapid and economical means of drying pitted, flattened dates were investigated. This work was done in cooperation with the Engineering and Development Laboratory of the Western Utilization Research and Development Division of USDA in Albany, California, where two types of driers were tested. Belt-trough drying was unsuccessful because the dates stuck together and dried very slowly; however, a laboratory-model through-flow drier was found to be well suited for this purpose. A 2.1-lb. quantity of pitted, flattened dates was spread approximately 3 deep on a 16-guage, 4-mesh wire screen and 170° F. air blown vertically through them. In 6 hours their moisture content dropped from 23.0% to 8.0%. The dried dates were of high quality, retaining much of their natural flavor and light color. Although this was a preliminary study the results indicate the usefulness of the through-flow method of dehydration as applied to dates. Commercial models have the added advantage of continuous operation. These factors are somewhat offset by high initial expense. However, throughflow driers should be given full consideration by the industry where new or replacement dehydration facilities are being installed.

DATE CONFECTIONS. These confections, containing approximately 14% of puffed-dried date powder, were prepared by the Southern Utilization Research and Development Division in New Orleans. They are light colored, have a fairly good date flavor, and possess excellent keeping quality. In their preparation 12.5 lbs. of puffed-dried date powder is used with 30 lbs. of sugar, 25 lbs. corn sirup, 5 lbs. liquid invert sirup, 0.63 lb. pectin, 0.17 lb. citric acid, 0.08 lb. sodium citrate and 2 gallons of water. The date powder, dissolved sugar, and sirups are brought to a boil. Pectin is added and cooked to 227° F. The dissolved citric acid and sodium citrate is

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added with constant agitation. When thoroughly mixed the liquid is cast in starch-coated molds and allowed to set overnight. Next day the jellies are removed and sugar sanded (5).

CHOCOLATE COATED DATE BAR. The date bar filling is the easiest of all the products to prepare and it could eventually provide the widest utilization for surplus dates. General appraisal of the chocolate date bar in limited taste tests has been very enthusiastic. Studies indicate excellent keeping qualities at room temperature. It is prepared from 78% coarsely ground pitted dates of relatively low moisture (approx. 15%), 7% liquid sorbitol, and 15% of a 76° Brix liquid invert sugar. The ingredients are mixed well into a paste (moisture content should not exceed 21.0%) which is then shaped into individual pieces and rolled in milk powder prior to chocolate enrobing. If desired, up to 15% of chopped nuts or other ingredients may be added to enhance the flavor of the finished product.

STABILIZATION OF DATE PRODUCTS

The rapid darkening of date fillings in cookies and other manufactured items is considered to be an important problem by the industry. This problem has been studied by a number of workers using various fruits. Joslyn *et al.* (2) found that the addition of specific amounts of citric and ascorbic acids retarded the browning of frozen apricots, peaches, and nectarines. Luther and Cragwall (3) obtained better results in preventing the browning of cut fruits by the addition of a citric-ascorbic acid combination rather than the use of either acid alone, even when the individual acids were used in larger quantities. Similar results were found in our studies in the case of pureed dates in which the addition of 0.2% citric acid together with 0.03% ascorbic acid was very effective.

Studies were conducted on a date puree prepared from 1 part of ground dates, 1½ parts of water, and with a small amount of toluene added to prevent microbial spoilage. (Toluene is not an edible preservative.) The puree was divided into 4 parts. One part was kept as a control, 0.2% citric acid was added to part No. 2, 0.1% ascorbic acid to part No. 3, and 0.2% citric acid and 0.03% ascorbic acid added to part No. 4.

The acids were added to the samples as 25% aqueous solutions and an equal amount of water was added to the control to maintain the same moisture content. The samples were held at 83° F. and the rate of darkening checked by reflectance measurements (4). The time required for the sample to reach 6% reflectance was arbitrarily chosen as a measure of the stability of the puree based on color. Purees having reflectance values below 6% were visually judged to be objectionably dark. Fig. 1 shows the results of this study. The addition of the citric and ascorbic acids initially lightened the color of the samples, and extended their stability. It is apparent that the addition of 0.2% citric acid together with 0.03% ascorbic acid is more effective than the addition of either acid alone, even when the individual acids are used in larger quantities. The stability of the sample treated with the citric-ascorbic acid combination was 2½ times greater than that of the control.

The cost of adding the citric-ascorbic acid combination is almost double that of adding citric acid alone. However, from Fig. 1 it is evident that the product treated with the citric-ascorbic acid combination had almost double the stability of the citric acid treated sample, thus justifying the increased cost.

The cost of adding 0.2% citric acid and 0.03% ascorbic acid to 1000 lbs. of puree is approximately $8. These additives should prove useful in retarding the darkening of other date products into which they can be thoroughly blended.

COATINGS

A consumer preference study with regard to the use of whole dates concluded that homemakers objected to their inherent stickiness (1). To overcome this objection, two simple and inexpensive coatings were tested. It was found that a 6% aqueous solution of any commercially available cold-water-soluble starch, or a 3% aqueous solution of methyl cellulose[3] formed a thin transparent film over the date. Dates can be coated either by dipping or spraying with either of the two solutions and subsequently dried with forced air. Lumping can be prevented by separating the individual dates after dipping and before drying. With either of the two coatings, the treated dates were less sticky than the untreated dates and remained shiny without any loss of natural color or flavor. Dates treated in this manner should be easy to handle in the packing plants as well as at home by the consumer. The coated dates present an attractive appearance in the conventional cellophane or polyethylene packs.

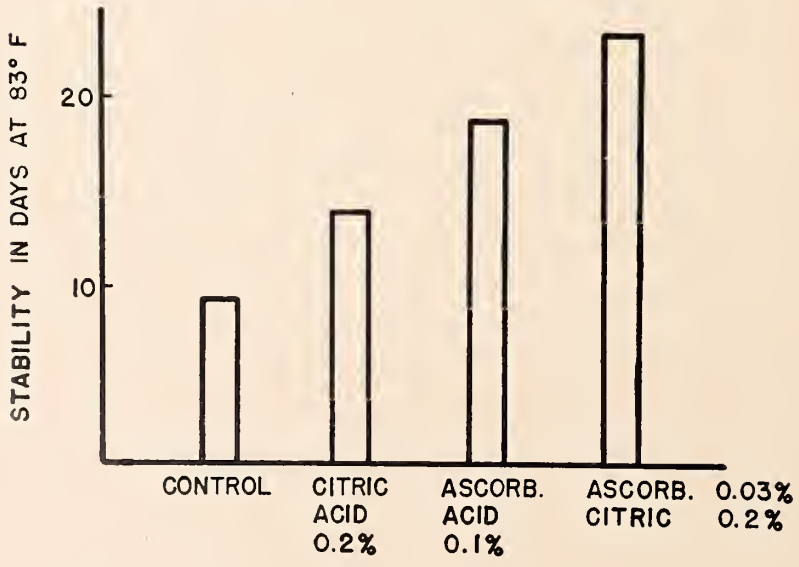

Figure 1. *Comparison of stabilities between control and treated samples of date puree in days at 83° F.*

[3]*Individual manufacturers should consult the Food and Drug Administration, Washington 25, D.C., and the food and drug officials of the individual states involved, to determine if the use of any proposed additive is permissible, and if so, what limitations are placed on its use.*

SUMMARY

Formulas and methods for the preparation of date sirup, date spreads, puffed-dried date powder, date jellied candies and chocolate coated date bars are given. A through-flow method of drying pitted, flattened dates is described. Data on retardation of darkening of date puree by the addition of 0.2% citric acid and 0.03% ascorbic acid are presented. Two methods of coating whole dates for the prevention of stickiness are described.

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ROOT DISTRIBUTION OF KHADRAWY DATE PALMS IN RELATION TO FREQUENCY OF IRRIGATION

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INTRODUCTION

During an investigation of the influence of length of interval between irrigations on the behavior of Khadrawy date palms (7), changes in the pattern of water extraction from the soil suggested that changes in root distribution may have occurred. This paper is concerned primarily with the results of an investigation of root distribution and of lateral water movement undertaken at the end of the irrigation experiment in an attempt to determine why the growth of some trees was apparently not affected by long intervals between irrigations during which the upper 3 to 5 feet of soil approached the wilting range.

The palms were 23 years old in 1958, when the root distribution investigation was made, and were growing in Indio very fine sandy loam beneath which were layers of sandy, silty or clayey soils of variable extent, thickness and depth. Water was applied every 2 weeks to the most frequently irrigated plots (2-week plots). Water was applied to the least frequently irrigated plots (indefinite plots) when water stress had reduced the leaf growth to 70 percent of that of the 2-week plots. Leaf growth was measured by means of a tape attached to a young leaf (2). Enough water was applied to the indefinite plots at each of the infrequent irrigations to leach the root zone and prevent salt accumulation.

The first drying period, cycle 1, varied from about 11 months to slightly over 12 months among the 4 plots of the indefinite treatment; in view of the variability of the soil it was surprisingly uniform. The surface sandy loam layer in indefinite plots 4 and 9 was shallower and the layer of fine sand immediately beneath was thicker and contained less silt and clay than in indefinite plots 7 and 14.

Plots 4 and 9 required water at slightly less than 11 months after the start of cycle 2 and again about a year after the start of cycle 3. Thus 3 irrigations were applied in a period of approximately 3 years. Twenty-three months elapsed before irrigation was required in plot 14. Plot 7 was not irrigated until the experiment was terminated 24 months after the start of cycle 2 because leaf growth was not reduced to 70 percent of the 2-week plots.

Sets of plaster-of-Paris moisture blocks were in operation in all indefinite plots throughout the experiment. Each set consisted of blocks installed in the soil at foot intervals to 6 feet, then one block at 8 feet and one at 15 feet. Each plot had one set of blocks renewed often enough to assure reliable readings.

The resistances recorded from the blocks installed at less than 6 feet indicated only small differences in the final moisture values attained among the 4 indefinite plots in the different drying cycles. The resistances of the blocks installed at 8 and 15 feet in plots 7 and 14 were strikingly different from those in plots 4 and 9. In plots 4 and 9 resistances remained at 400 to 600 ohms, about field capacity, at 8 and 15 feet throughout all cycles. In plots 7 and 14 at the end of cycle 1 the resistances were 3000 ohms at 8 feet and 700 ohms at 15. In cycle 2 the soil in these plots began to dry about a month earlier than in cycle 1; and 11 months after the start of cycle 2, at the time plots 4 and 9 were irrigated for the second time, block resistances in plots 7 and 14 were about 3000 ohms at 8 feet and 2000 ohms at 15. Throughout this period the soil at 8 and 15 feet in plots 4 and 9 was at about field capacity.

By the end of the second cycle in plots 7 and 14, 23 months in plot 14 and 24 months in plot 7, the resistances were about 12,000 ohms at 8 feet and about 5000 ohms at 15 feet, but the growth rate of palms in plot 7 was still greater than 70 percent of that of the palms in the 2-week plots. Cycle 3 had ended in plots 4 and 9 about a month before the end of cycle 2 in plots 7 and 14.

Possibly absorption of water by the roots in the upper layers was greatly reduced by the extreme dryness of the soil and this induced greater water absorption and growth of the roots in the lower levels. We have used the term "vertical compensation" to describe the increase in irrigation interval and greater water use in the deep subsoil.

Root sampling was undertaken to investigate the possible differences in root distribution in the compensated indefinite plots 7 and 14, the uncompensated plots 4 and 9 and the 2-week plots.

EXPERIMENTAL METHODS AND RESULTS

Investigation of Differences in Root Distribution

Root samples were taken in 1-foot increments to a depth of 23 feet with a Retzer auger at 3 stations in each of the four 2-week plots and each of

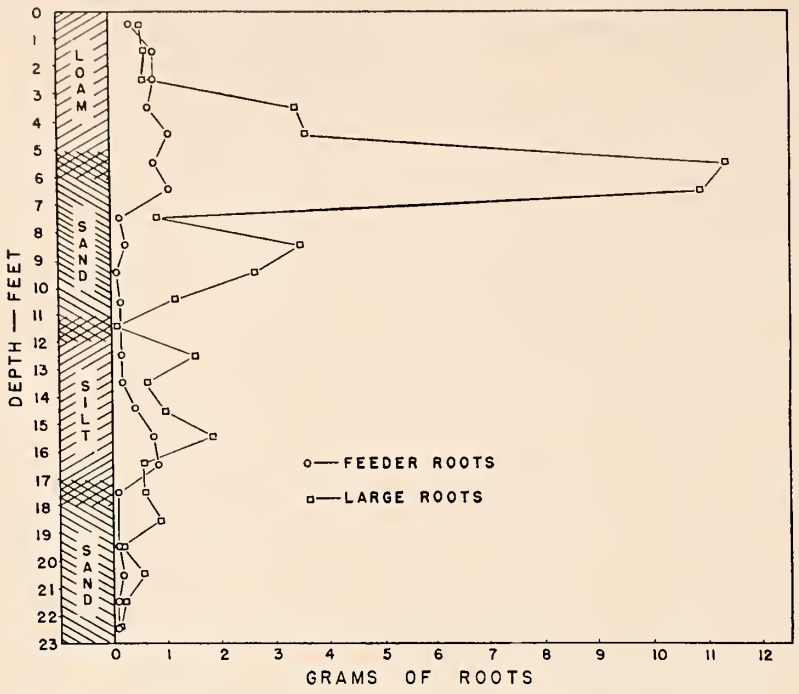

Figure 1. *Root distribution in plot 14, showing the relation between feeder roots and large roots of Khadrawy date palms irrigated at infrequent intervals and between soil type and root density as grams of roots per cubic foot of soil.*

the 4 indefinite plots. The roots were sorted by size into feeder roots—those less than 1 mm in diameter—and large roots—those greater than 1 mm in diameter — air-dried and weighed. Statistical analysis of the sample weights showed no significant difference between the 2-week and the indefinite plots in the amount of feeder roots, large roots, or total roots in the 23-foot profile. A comparison of the total weights of roots in the top 12 feet and in the lower 11 feet of the zone sampled in the 2-week and the indefinite plots showed no significant differences in distribution at these levels. Any differences in root distribution between the 2-week plots and the indefinite plots were completely masked by the high degree of variability among the replications. The mean weight of all roots from the 23-foot profile in all the indefinite plots was 29 grams of roots per cubic foot of soil and from the 2-week plots it was 33 grams per cubic foot. The mean total root density in uncompensated plots 4 and 9 was 26 grams per cubic foot and in compensated plots 7 and 14 was 32 grams per cubic foot. The variability among these plots was so great that these differences are not significant; so there may be no real difference in root distribution between any of the plots.

Changes in soil texture were not abrupt; rather the transition zones were a few inches to several feet thick; and the strata and transition zones varied in depth and thickness to some extent from hole to hole in the same plot. These factors prevented statistical comparison of the root-distribution data with the soil texture encountered as the sampling holes were bored.

In layers where there was a high density of feeder roots there was also a high population of large roots, Figure 1. While the two curves are not parallel, they are similar in shape, the main difference being the degree of amplitude. The highest density of roots was at 5 to 7 feet, deeper than expected from experience with other tree crops.

Many workers have made root distribution studies which showed that from 85 to more than 95 percent of the roots of trees and shrubs were in the top 3 to 4 feet of soil (4, 5, 6, 9, 10, 11, 14). Even Tamarix, which had roots extending to 48 feet of depth in the soil, had 95 percent of its roots in the top 4 feet (14). Pillsbury (11), using transpirational water use as an indication of root distribution, showed that 95 percent of the roots of the date palm were in the top 6 feet of soil. In 9 plots there were 3 exceptions to this shallow-rooting pattern. These exceptional plots had more roots in the 2 to 4-foot zone than in the upper 2 feet; but even though they had more roots at 4 to 6 feet than any of the other plots, less than 25 percent of the roots were at this depth. In none of the 9 plots were more than 4 percent of the roots at 6 to 8 feet of depth.

As indicated in Figure 1, there was a marked association between high root density and silty or clayey soil. Furr and Taylor (8) showed that in citrus growing in a stratified soil, practically no roots were produced in layers of coarse, sandy material.

Investigation of Lateral Water Movement

Lateral water movement in unstratified soils is very limited in extent (3, 8, 12), but in stratified soils, where impermeable or slowly permeable layers occur in the soil, considerable lateral movement of perched water may occur (13). In an irrigation experiment on date palms growing in a stratified soil at the H. L. Cavanaugh garden in Coachella Valley, Aldrich, Crawford and Moore (1) found that lateral movement through several feet of soil occurred.

When we failed to find that significant changes in root distribution had occurred in plots 7 and 14, it seemed possible that the continued normal leaf growth might have been in response to lateral water movement from adjoining plots in sand layers underlain by layers of low permeability. Perched water, under a hydrostatic head, might have moved laterally for some distance through the sand and effectively wetted a part of an adjacent dry plot. Four sets of plaster-of-Paris moisture blocks were installed in one of the very dry plots at various distances from an area that was to receive heavy irrigation. Each set consisted of blocks at foot intervals to 6 feet, a block at 8 feet, one at 15 feet and one at 20 feet of depth. At no time during or after the application of several feet of water to the surface of the wet area was lateral water movement detected by any block at any station, even though the closest station was only about 6 feet from the irrigated area.

CONCLUSIONS

Most workers have agreed that there is a high degree of correlation between water use and root density where other factors, such as evaporation and drainage, are controlled. The results of analyses of the root distribution data herein reported do not support this assumption probably because of variability in the samples. If there was an increase in root density below the principal root zone in plots 7 and 14 it was probably small and was completely masked by sampling error.

At least two other possible explanations for the compensation exhibited by plots 7 and 14 exist. One is that perhaps, since the root system obviously extended below 23 feet, appreciable water was obtained from depths greater than considered in this investigation. Another possibility is that the palms in the compensated

plots had, at the beginning of the experiment, some roots that extended into the neighboring, freqently irrigated plots, and that, through the years that the experiment was continued, these roots ramified until they were capable of supplementing the water supply of the compensated palms and maintaining them in good growth for indefinite, lengthy periods. The palms in plots 4 and 9, because of poor soil conditions, may have had few roots, or no roots, that extended into neighboring wet plots at the beginning of the trial. Some of the irrigated areas were as close as 28 feet to the nearest palms in the 4 indefinite plots and in no case was the distance greater than 45 feet. While it is possible that the buffer distances were too short in this trial, experience in previous irrigation trials in this block of Khadrawy date palms indicated that 30 feet of buffer area was sufficient to suppress interaction.

SUMMARY

Khadrawy date palms, growing in Indio very fine sandy loam, were allowed to suffer severe water stress before irrigation. Differences in water extraction and length of irrigation interval between some of the dry (indefinite) plots and between the dry plots and the frequently irrigated plots suggested that differences in root distribution had occurred; but when samples were taken to determine root distribution, significant differences in root distribution did not appear. Roots extended to at least 23 feet of depth; root density was higher in clay or silt layers than in sand layers, and peak root density was at 5 to 7 feet. The possibility that lateral water movement through the soil from a frequently irrigated plot into a dry plot was responsible for maintaining leaf growth at normal levels was investigated by the use of plaster - of - Paris resistance blocks. Lateral movement through 6 feet of soil did not occur to a depth of 20 feet. While changes in root distribution or lateral water movement may not have been responsible for maintaining near normal leaf growth rates, growth may have been maintained by water absorption by roots below 23 feet of depth or by ramification of roots invading neighboring wet plots.

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THE RELATION OF GROWTH, YIELD AND FRUIT QUALITY OF DEGLET NOOR DATES TO VARIATIONS IN WATER AND NITROGEN SUPPLY AND TO SALT ACCUMULATION IN THE SOIL

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In an experiment started in 1954 in a block of Deglet Noor palms planted in 1941 on Indio very fine sandy loam, water from the Coachella Valley Branch of the All-American Canal was applied to plots in three different irrigation treatments as follows: High (H), 14 feet per year; Medium (M), 10 feet per year; and Low (L), 6 feet per year. One half of each plot was unfertilized; the other half was heavily fertilized with manure and ammonium nitrate at rates of 8 to 13 pounds of nitrogen per tree per year from 1954 through 1958. The original purpose of this experiment was to determine whether wide variations in the water and nitrogen supply to the trees would appreciably influence the quality of the fruit produced. This experiment has been described and the results from 1954 through 1957 reported (2). The present paper reports the results of the fifth and final year's work including the possible effects of differences in salt accumulation in the different plots.

Because of an insufficient number of trees available, the treatments in this experiment were not replicated, and statistical analysis of the results was, of course, not possible.

One set of samples, composed of 6 cores from each foot to a depth of 16 feet, was taken from the fertilized half and the unfertilized half of each plot. Another set was taken to determine the relation between salt accumulation and the distance the water had to flow from the upper end (tree 1) of the irrigation run. In an irrigation run there were 8 trees spaced 30 feet apart, and samples were taken under trees 1, 3, 5 and 7 in one row of each plot. The soil samples were wet to saturation, the "saturation extract" removed by suction and the electrical conductivity of the extracts determined as described in the U. S. Salinity Laboratory Handbook (3). The approximate percentages of salt in the soil samples were calculated from formulae in the Salinity Laboratory Handbook (3):

$Psw = P.P.M./10{,}000 = 0.064 \times EC \times 10^3$;
$Pss = (Psw \times Pw)/100$.
Psw=percent salt in water;
Pss=percent salt in soil;
Pw=percent of water in soil. The amounts of total soluble salts to depths of 8 feet or 16 feet were calculated from the percentages of salt in the samples and the weight of the soil, which was assumed to be 3,000,000 pounds per acre-foot. Actually, the weight of the sandy layers of soil was probably more nearly 4,000,000 pounds per acre-foot, but because of uncertainties as to proportions of sandy and silty soil the estimates of the salt content were based upon the lower weight. Thus the estimated amounts of salt in the soil were probably somewhat lower than the actual amounts present.

The electrical conductivity of the saturation extract is recommended by the U. S. Salinity Laboratory (3) "as a measurement for general use for indicating soil salinity." As a result of extensive work on the influence of salinity on the behavior of plants the U. S. Salinity Laboratory has classified many of the common field, vegetable and orchard crops according to their relative tolerance of salt concentration as measured by the conductivity of the saturation extract in millimhos per centimeter at 25° centigrade. For example, the growth of salt-sensitive crops such as citrus, avocado and peach is appreciably restricted at conductivities of 2 to 4 millimhos; that of crops of medium sensitivity such as fig, grape and pomegranate, at conductivities of 4 to 8 millimhos; and that of tolerant crops such as asparagus and the date palm, at conductivities of 8 to 16 millimhos.

RESULTS AND DISCUSSION

Salt Accumulation

The conductivities of the saturation extracts of the soil samples taken opposite trees 1, 3, 5 and 7 from near the upper to near the lower ends of the rows, or irrigation runs, were plotted to show the relation of salinity to soil depth and position along the irrigation run.

It is apparent that salt accumulation was relatively low in plot H and relatively high in plot L (Figure 1). The conductivity values of the samples from plot M were intermediate between those of plots L and H and are not shown. The conductivity of the saturation extract of the soil from depths of 6 to 8 feet in plot H was about the same as that of the canal water applied, that is, 1 to 1.2 millimhos; but even at the high rate of application of 14 feet of water per year there was some accumulation of salt at 2 to 6 foot depth. This accumulation probably occurred in summer and early fall, since with fairly uniform intervals between water applications the lowest soil-moisture level of the year in date gardens usually occurs in early fall. The salt accumulation in plot H, where conductivities rarely exceeded 3 millimhos, probably never measurably affected the trees. In plot L salt

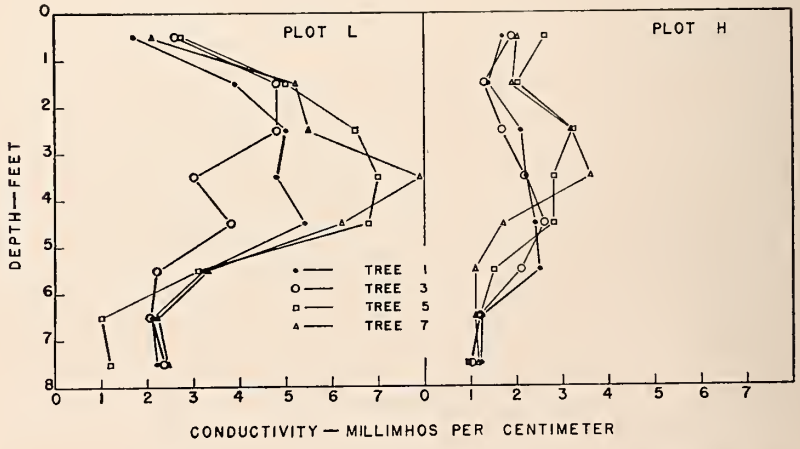

Figure 1. *Relation of the electrical conductivity of the saturation extract to soil depth and to position in the irrigation run from upper (tree 1) to lower end of the run.*

Table 1. Accumulation of total soluble salts in plots H, M and L in relation to soil depth, to position in the irrigation run and to the amounts of water applied.

Plot and water applied per year	Tons salt per acre 8 feet Tree number: 1	3	5	7	Tons salt per acre 16 feet Upper half of plot (—N)	Lower half of plot (+N)
H (14 ft.)	6.1	5.4	6.5	6.2	7.4	11.4
M (10 ft.)	6.3	9.2	7.5	9.4	12.3	16.8
L (6 ft.)	10.4	10.8	10.5	12.5	20.2	22.4

Table 2. Leaf-growth index[1] of Deglet Noor dates from 1954 to 1958 in relation to nitrogen fertilization and water supply.

Treatment of subplot[2]	1954	1955	1956	1957	1958
L —N	86	83	85	85	90
H —N	91	85	85	85	86
M —N	97	95	94	97	99
L +N	107	109	109	107	104
H +N	106	110	112	113	111
M +N	113	119	114	113	110

[1]Leaf-growth index: average growth rate of all trees 1954—1958=100.
[2]L —N: 6 ft. water; no fertilizer.
L +N: 6 ft. water; N fertilizer applied, etc.

Table 3. Average bunch production and yield, grade and weight of Deglet Noor date fruit in 1958 under the different irrigation and nitrogen fertilization treatments.

Treatment	Bunches per tree Total (no.)	Mature (no.)	Yield per tree (lbs.)	Fruit grades[1] A (%)	B (%)	C (%)	D (%)	Weight per fruit (gms.)
H (14 ft.)	17.0	12.7	236	0.6	15	73	20	10.3
M (10 ft.)	16.0	12.4	208	1.0	22	68	9	10.7
L (6 ft.)	15.7	12.0	143	1.0	18	70	12	9.7
+N	18.5	14.0	231	0.7	14	75	11	9.9
—N	14.0	10.7	202	1.2	24	66	9	10.6

[1]Grades: A=Top natural
B=Select natural
C=Standard dry
D=Sub-standard and culls

accumulation was pronounced at a depth of 2 to 5 feet and was greatest at the fifth and seventh trees. The conductivities of many of the samples from this plot were 4 to 7 millimhos, a salinity level that would seriously limit growth of citrus interplants and probably would affect dates. The electrical resistance readings of gypsum blocks used in plot L to show the soil-moisture conditions indicated that in summer and fall the soil in the top 3 or 4 feet had usually lost a large part of the available moisture before each application of water. At a depth of 16 feet in early winter the resistance readings sometimes reached 1600 ohms, an indication that the soil was drying out measurably even at depths where root concentration was low. This degree of drying of the soil undoubtedly resulted in appreciable concentration of the soluble salts in the soil water in plot L.

Each acre-foot of canal water contained approximately 1 ton of salt. With thorough leaching, as was obtained in plot H, and adequate leaching, as was obtained in plot M (Table 1), there was not an injurious accumulation of salts. With scarcely enough water applied, however, to meet the transpirational needs of the trees in plot L during the growing season and with inadequate leaching in winter, at least 20 tons of soluble salts had accumulated in the top 16 feet of this plot when sampled (Table 1).

The accumulation of salts was greater in the lower ends of plots H and M than in the upper ends, an indication, of course, that leaching was more thorough in the upper part of an irrigation run than in the lower part even though only a short time was required for water to cover the moderately pervious soil surface. From mere observation of the plots it appeared that water was being applied nearly evenly over the entire surface, but apparently this was not true. Except for the upper half of plot H, nearly as much salt was found in the second 8 feet as in the top 8 feet of all three plots. This fact suggests that thorough leaching out of soluble salts from the 8 to 16 foot zone was not achieved during the preceding winter and spring when water application presumably most greatly exceeded transpirational use. Much of the water displaced from the upper 8 feet of soil during the winter probably remained in the 8 to 16-foot zone because not enough water was applied to displace this saline water from the entire upper 16 feet of soil.

Growth, Yield and Fruit Quality

The leaf-growth index was used as a relative measure of growth of the trees in each treatment (leaf-growth index: average annual leaf-growth rate of all trees 1954—1958= 100).

Leaf-growth rate was determined throughout the year by observing the distance through which a 1.5-meter steel tape attached to the rachis of a young leaf was drawn during periods of one to several weeks (1). From these measurements the average annual leaf-growth rate of each plot and subplot was calculated.

The leaf-growth indices of the 6 subplots indicate that nitrogen fertilization produced a marked difference in leaf growth during the entire period of 5 years (Table 2). If leaf growth was affected by salt accumulation in the several subplots, however, this effect was obscured or confused by the influence of nitrogen fertilization and possibly by that of water supply or even by leaching of nitrogen from plot H. In 4 out of 5 years subplot L —N had as low a leaf-growth index as any other subplot and subplot L +N the lowest of the fertilized subplots. These observations suggest that water shortage and possibly salt accumulation suppressed growth on plot L.

As in the first 4 years of this experiment (2), the average production of fruit bunches per tree in 1958 was nearly the same in the three irrigation plots and greater in the subplots that received nitrogenous fertilizer than in the unfertilized ones, in spite of the fact that salt accumulation was greater in the fertilized subplots than in the unfertilized (Table 3).

Only broken or damaged, immature bunches were removed from unfertilized trees, but a few sound bunches were cut from heavily loaded fertilized trees. The average number of bunches carried to maturity was nevertheless greater on the fertilized trees than on those not fertilized. The average yield of fruit per tree in 1958 was greatest in plot H, and least in plot L (Table 3). During the first 3 years of the experiment yields seemed to be entirely unrelated to irrigation treatments; for example, in 1955 the highest yield was in plot L. In 1957, however, the yields of plots H, M and L were respectively 260, 205 and 188 pounds per tree (2). This pattern was repeated in 1958 and there was a larger difference in yield between plots H and L in 1958 than in 1957. These facts strongly suggest that differences in water supply and in salt accumulation affected the yields in 1957 and 1958. The variations in amounts of water applied or in salt accumulation may not have influenced the grades of fruit produced in 1958, though, as in previous years, the unfertilized trees produced fruit of somewhat better grade than the fertilized trees.

Because the poor quality of fruit from the lower and fertilized half of plot H could not be attributed to salt accumulation, the lowering of fruit quality in the fertilized subplots was attributed to excessive nitrogen fertilization. The small average size (weight) of fruit from the +N subplots and from plot L suggests that fruit size may have been adversely affected by the heavy crop on the fertilized trees and by salt accumulation and water shortage in plot L.

The results obtained in 1958 show that, just as during the first 4 years of the test, while growth and yield were greatly improved by heavy nitrogen fertilization, fruit quality was not improved but, on the contrary, somewhat impaired. The yields of plot L were probably reduced in 1957 and 1958 by water shortage and soil salinity, but grades of fruit were not measurably affected by variations in water supply and salinity under the different treatments.

SUMMARY

In a 5-year irrigation and nitrogen-fertilizer trial with mature Deglet Noor dates, water containing about 1 ton of salt per acre-foot was applied to different plots at rates of 6, 10 and 14 feet per year and to one half of each irrigation plot nitrogenous fertilizers were applied at rates of 8 to 13 pounds of N per tree per year. Soil salinity in the top 16 feet of the root zone was estimated from soil samples taken at the termination of the trial. With the application of 14 feet of water per year conductivities of the saturation extracts were mostly below 3 millimhos per centimeter, but with 6 feet per year the conductivities from many samples were 4 to 7 millimhos per centimeter. The conductivity values of samples from the plot that received 10 feet of water per year were intermediate between those of the other two plots. The accumulation of salt was considerably greater in soil of the lower half of the irrigation run than in the upper half, but was about the same in the top 8 feet as in the 8 to 16-foot zone. Total soluble salts in the top 16 feet of the different plots ranged from 7.4 to 22.4 tons per acre. With the application of 10 feet of water per year salt removal was adequate, but with only 6 feet it was not.

Leaf growth and yields were greatly improved by heavy nitrogen fertilization, but the quality of fruit from fertilized trees was lower than that of fruit from unfertilized trees. In the first 3 years of the trial, yields and fruit quality were apparently unaffected by the variations in water supply, but in the last 2 years yields were reduced in the plot that received only 6 feet of water per year, probably as a result of water shortage and increased salinity. During the entire 5 years fruit grades were not measurably affected by the variations in water supply or salinity.

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TEMPERATURE AND ITS RELATIONSHIP TO THE DATE CROP

By Robert E. Cook
California Date Growers Association

This report is intended as a "follow up" report on work previously presented by the writer (1) in the matter of forecasting time of ripening of the Deglet Noor date crop by means of recording heat units. Observations of the last 3 crops have proved this system to be of value to the packing house. It is an added tool to aid in doing a better job of planning.

The problem of when to start in computing heat units is still not settled. In the previous report, December 1 was used, but this is not entirely satisfactory. With most other tree crops, bloom time is used as the starting point, but with dates blooming over a period of 8 to 10 weeks this is not easy to pin down to a definite day. We are not yet prepared to say if it should be when the first blooms open, or possibly when 10%, or 50%, or some other percent of the blooms are pollinated.

Whatever starting point is used, if some allowance for an early bloom or late bloom is made, a fairly accurate prediction of when the crop will ripen can be made by June 30. A study of what has happened in previous years indicates that temperatures from June 30 to Sept. 15 usually effect ripening time by no more than a day or two. In fact by the end of April, using heat units to that time and making an educated guess as to what the weather is going to do during the next 4 weeks we can get a good indication of what we may expect as to time of ripening.

This brings us up to where we are right now (April 25). Most growers agree that the start of pollination was about normal this year; that is, pollinating got under way the last week in February. Computing from March 1 we have already had sufficient heat units to bring the crop in 8 days early. The weather service forecasts the temperature for the first half of May as above normal, so this year could be a repeat of last year, and might even be earlier. In fact, going back 30 years, we find only one year with a March and April that were warmer than this year; 1934 being the one year which was hotter, and also the year which produced the earliest crop in the history of date growing in Coachella Valley. Data on other early crops is as follows:

Year	Date 2% Picked	Number Days Ahead of Normal	Percent of Crop Picked by Oct. 31
1958	Sept. 17	4	72
1947	Sept. 13	8	67
1940	Sept. 3	18	89
1939	Sept. 11	10	65
1936	Sept. 5	16	91

Records of starting time of pollination are not available so true comparisons of heat units cannot be made, but March 1 through June 30 in each of the above years provided sufficient heat units so that these early crops could have been predicted, likewise the late crops of 1944, 1945, 1951, 1953, and 1955 could have been predicted by June 30. In order to obtain greater accuracy in making these forecasts more sources of weather information are needed: i.e. —more thermometers and someone to read them. Heat units at any one location are accurate only for that particular location.

If the valley were divided into 3 or more zones, each with 2 or more growers to record temperatures, then a central headquarters could compute the heat units and forecast ripening time for each zone. This information together with crop estimates for each zone would provide a means of forecasting the amount to be harvested each week or each month during the harvest season.

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THE USE OF POLYETHYLENE WRAPS IN THE ROOTING OF HIGH DATE OFFSHOOTS

By Daniel Raz

It has been known for years that the date palm does not come true from seeds, and that about 50% of the seedlings are males. Therefore, the main method of propagation has been from offshoots.

In most countries, the lower offshoots are rooted to the ground, and later severed from the mother and planted in the nursery or directly in the orchard. Generally, the offshoots grow at the expense of the fruits, and the growers limit their number according to their needs.

But in some cases, where there is a big demand for offshoots, it is economical to utilize every one, including those produced higher on the trunk.

The survival of unrooted offshoots is, in general, very low, and they require nursery conditions.

The rooting of high offhsoots on the palm is done by cleaning the base of the young plant near the trunk, and surrounding it with wet soil, kept in place by a wooden box. This method was known in the Old World (6), but developed independently in the U.S., first in Coachella Valley by Faris (5), and later by Crider (3) in Arizona.

The method was used on a wide scale in Israel after 1949, when there was a big demand for offshoots. An improvement was made on the method by changing the rooting media from soil to shavings, which were much easier to handle. Moreover, the shavings favored rooting and held the water better. But this method is expensive. It is estimated that one man can box only five offshoots per day using this technique. The boxing materials are costly, and the frequent watering provides additional expenses.

A further improvement was made by the author in Israel in the winter of 1956. Instead of building boxes, an open tube of polyethylene, first folded to form a ring, was slipped over the offshoot, opened, tied at the bottom and filled with wet shavings. The top was then tied. After a few weeks, roots were seen through the polyethylene. In the spring, the rooted offshoots were successfully removed and planted.

There are several advantages in this method:

1. It saves work involved in cleaning the mother palm and building boxes.
2. It saves materials (and polyethylene is much cheaper than wood and tin).
3. It saves watering.

This method was tried on a wider scale in the orchard of Mr. D. H. Mitchell, Indio, California, in the winter of 1958. The shoots were rooted and planted in the spring of 1958, and took well.

It has since been used commercially in Israel, and seems to have become the main method of propagating palms there. (12)

This method again raises the question of the value of the higher offshoots, which are considered in some of the Oriental countries (10, 11) to be of lower quality (In Iraq they were termed "bastards," and in Egypt "boil" or "canker"). Since this tradition has no scientific basis, it seems to have originated because of the fact that the higher offshoots are not easily rooted and are very low in survival. Since there is a surplus of offshoots in these countries, they usually have been destroyed.

Although no carefully controlled experiments have been carried out (9), there are clear observations by reliable farmers that in the varieties Hiany (11, 12), Deglet Noor and Medjool (8), palms from higher offshoots prosper as well as those from lower offshoots.

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13. *I wish to extend sincere thanks to Mr. D. H. Mitchell of Indio for his cooperation, and to Prof. C. A. Schroeder for reading and correcting this paper.*

THE FUTURE OF THE DATE INDUSTRY IN COACHELLA VALLEY

By **William W. Cook,** grower

This paper is designed to present such factual data and informed opinion as could be secured pertinent to the drawing of sound conclusions as to the future of the Date Industry. Where definite conclusions could be reached, such findings are incorporated. Beyond this, it will be left to the reader to make his own evaluation of factors and circumstances enumerated and to draw his own conclusion as to the ultimate future of the Date Industry in Coachella Valley. This may be of little importance to the future of total United States agriculture, for the Date Industry is not large when compared to the national agricultural production. On the other hand, the Coachella Valley is the single area in the United States that has developed and maintained a significant volume of date production. It is the only area in the United States known to have the peculiar combination of soil and climatic condition favorable to the development of additional date production. This is particularly true in so far as the Deglet Noor variety is concerned. It appears reasonable to assume that the future of the Date Industry in the Coachella Valley represents the future of the Date Industry throughout the United States.

The following specific points will be covered in detail:

1. Acreage and Production data.
2. A ten-year forecast of acreage and production.
3. Conclusions that can be drawn from items 1 and 2.
4. Factors affecting probability of new planting of dates.

The logical first step is an analysis of present acreage and a study of past acreage and production figures. Fortunately, the Riverside County Agricultural Commissioner's office has recently completed a thorough survey of Coachella Valley date acreage. The results of this census, plus a tabulation of new plantings made during the past ten year period, is presented in Table 1. It will be noted that only six percent of present acreage was planted during the past ten years, and that as of now there are only 120 acres of young, non-bearing date palms growing in the Coachella Valley. (See also 1958 acreage figures shown in Table 2.) Bearing in mind that good practice dictates the removal of all offshoots from palms reaching full bearing age, the potential for future plantings of offshoots of standard varieties is clearly limited. When considered upon a varietal basis, the one exception to this situation is the Medjool (or Medjhool) variety.

An estimate of the present acreage of Medjool date palms is incorporated in Table 1. Acreage expansion by the planting of all available offshoots of this variety is anticipated for the next several years. Given proper care and orchard management, grower per pound returns on present production are very high. Due to the greater than average labor requirement, the careful management needed, and the relatively low yield per palm, the Medjool variety is not expected to rival Deglet Noor tonnage. It does offer a highly favorable medium for date orchard diversification and may well provide as much as a quarter of total date acreage at some future date. The special situation as to this variety should be kept in mind as consideration is given to the over-all Date Industry future.

Total date acreage and production data is given in Table 2 from 1925 to the present. This material was secured from the Riverside County Agricultural Commissioner, who added the following comment:

"The last recorded period of extensive planting was the five years ending in 1945. Some thousand acres were planted in this period.

"Since 1951, removals of date palms have exceeded plantings by 332 acres.

"During the past two years 126 acres have been removed, 41 acres planted, representing an excess of removals over plantings of 85 acres.

"In excess of 75% of present date acreage consists of palms twenty years of age or older."

An effort was made to determine the number of offshoots of standard varieties now available for planting. A composite of the somewhat diverse opinion secured produced an estimate of 7,000 offshoots and palms in nursery, or a potential total 1959 planting of less than 150 acres.

No dependable information could be secured as to the total acreage now definitely committted for removal in the near future. It was indicated that such commitments must approximate 200 acres and that, within five years, at least 500 acres of present bearing acreage will be removed.

In view of the present age of existing bearing palms, the small acreage of young non-bearing palms, and the pressure of subdivision and in-

Table 1. Census of Coachella Valley Date Acreage in 1958 and Plantings Last Ten Years (1948-58)

Variety	Total Acres 1958	Acres Planted 1948-58	Percent, Col. 2 of Col 1
Deglet Noor	4,008	182	4.5%
Khadrawy	166	21	12.6%
Zahidi	139	5	3.6%
Medjool[1]	55	40	72.7%
Halawy	44		
Saidy	11 } 90	21	23.3%
Other Varieties	35		
Seedling	88	3	3.4%
	4,546[2]	272	6.0%

[1]Medjool acreage estimated by Roy W. Nixon, D. H. Mitchell, and W. W. Cook.
[2]4,426 acres bearing, 120 acres non-bearing.

Table 2. Date Production and Acreage for Riverside County

Year	Bearing Acres	Non-Bearing Acres	Total Acres	Production* (in tons)	Valuation**
1925	680	1,095	1,775	305.0	$ 305,000
1930	662	1,011	1,673	1,490.5	596,159
1935	1,215	1,660	2,875	3,203.5	384,446
1940	2,706	308	3,014	5,671.0	623,848
1945	3,049	1,059	4,108	4,500.0	2,377,622
1950	3,891	950	4,841	13,875.0	5,243,160
1951	4,062	816	4,878	18,125.0	6,305,000
1952	4,383	436	4,819	16,750.0	4,910,000
1953	4,596	171	4,767	14,547.5	4,293,100
1954	4,404	174	4,578	13,875.0	3,847,500
1955	4,433	133	4,566	16,682.5	4,236,050
1956	4,435	106	4,541	26,246.0	7,371,220
1957	4,493	126	4,619	21,753.0	5,285,900
1958	4,426	120	4,546	22,938.0	7,004,040

*Production is total tons produced of all varieties and grades, cull & Substd. included.
**Valuation is total-gross FOB sale value of above tons.
Source, Tables 1 & 2: Riverside County Agricultural Commissioner. Except: Medjool acres in Table 1 were included in "Other Varieties" by County.

dustrial land use expansion, a consensus was found that the highest probability is for a ten percent reduction in bearing date acreage during the next five years, to be followed by a like reduction in bearing acreage the following five years. The time lag of some seven years between planting and significant production precludes a substantial increase in young bearing palms during the next ten years unless planting stock be imported.

Based upon facts and opinions presented to this point, the following specific forecast is made:

It is predicted that ten years from now; that is, in 1969; the Coachella Valley Date Industry will consist of not more than 3,500 bearing acres in full production, plus from 200 to 300 acres of young, partial bearing palms. This will provide a total 1969-70 date crop, assuming average weather conditions, of some eighty percent of recent volumn, or approximately twenty thousand tons. Regardless of how much planting be stimulated, this is the volumn that may be expected ten years from now. It is true that a large acreage of nonbearing palms could exist at that time if all available planting stock be utilized during the intervening 10 years.

From the foregoing, it is clear that the Date Industry faces a critical period. If new plantings are not made, if planting stock be destroyed, the stage will be set for the decline of the present industry, beginning in the early 1970's. If this is permitted to take place, either a new group of pioneers will start a new date industry or the commercial production of dates will vanish from the economy of the United States.

Planting of date acreage could be made for several reasons:

1. Expectation of profit from fruit production.
2. Expectation of reveune from sale of offshoots.
3. Diversification by farmers growing other crops.
4. Ornamental use of palms in borders, etc.
5. Shade, and/or frost protection for other crops or livestock.
6. The romantic implications of the Date Industry.

There may be other reasons, but even if there are, it appears unavoidable to conclude that no significant planting of dates will be made in the absence of an expectation of adequate profit from the production of fruit. Accepting this conclusion, an effort was made to develope a figure for net profit per acre that would serve to stimulate the planting of date offshoots.

Agreement was found that, using today's costs, a minimum investment of three thousand dollars per acre is required to provide land of suitable quality, plant it to date offshoots and carry the cost of care to the date of commercial bearing. It was also found that general agreement existed that a return on investment of ten percent was required to justify putting capital into a long term investment of this character. If this be accurate, planting will not be encouraged until the investor can see a reasonable probability of averaging $300.00 per acre net profit above all costs, including depreciation and management.

A considerable spread of opinion was encountered when an effort was made to translate this into required grower return per pound. Opinion ranged from eight to fourteen cents per pound of marketable dates as the rate necessary to permit a net profit of $300.00 per acre. Recognizing the possibility of future inflation, and making allowance for poor returns in seasons of adverse weather, a realistic return per pound on all dates above Substandard grade that would serve to stimulate substantial planting of offshoots appears to be about eleven cents. This rate should provide a gross income in a favorable year of fifteen hundred dollars per acre.[1] The average gross, over a long period, would exceed a thousand dollars per acre.

If it be accepted that stimulation of planting is necessary if the Date Industry is to have a future, and that an anticipated grower return of 11c per pound is required to encourage planting, then the long term future of the Date Industry hinges upon the development of circumstances sufficiently favorable to convince a prospective investor that an 11c return is not only possible, but that it is highly probable. This conviction of probability must develop within the next few years if a drastic reduction in domestic date production is to be avoided in the 1970's. The balance of this paper will be devoted to the presentation of such factual material and informed opinion as could be secured and which has a bearing on the probability of grower returns reaching the required level. It is hoped that this material will be of help to any one brave enough to make a specific forecast of the long term future for the Date Industry.

Average grower returns per marketable pound have approximated seven cents in recent years. Growers who produce fruit of high average quality have received well above eight cents per marketable pound.[2]

A study of prices quoted during the past five years indicates a reasonably steady price level in wholesale markets. There is some evidence of strengthening at present. During the past few years there has been a consistent trend toward a higher percentage of the total date crop being distributed by large handlers who ship to all major markets.

Operation of the U.S.D.A. Marketing Order for Dates has had a material effect by tending to equalize volume placed on the market in whole date form from season to season. A study of Tables 3 and 4 will show this to be true. It is evident that the activities of the Date Administrative Committee, along with action by packers and shippers, has developed greater market stability and greater industry stability. Table 3 clearly shows that the "Products"[3] use of restricted date tonnage has furnished a "Surge chamber" permitting annual equalization of market volume of dates placed in regular channels of distribution. Despite the problems placed upon the smaller packer in "Products" development,

[1] 16,000 *Lbs. field run, of which* 4% *cull,* 10% *substandard, and* 86% *marketable; or* 13,760 *pounds marketable at* 11c *each, providing* $1,513.60.

[2] *Grower return figures based upon data supplied by California Date Growers Association and Valley Date Gardens.*

[3] *"Products and "Product Dates" are terms used by the Date Admin. Com. to denote dates utilized in the making of sundry food products, such as syrup, cake and cookie mix, candies, etc.*

Table 3. Comparative Figures on Last Four Date Crops

(Pounds are shown in millions of pounds and cover Deglet Noor, Khadrawy & Zahidi varieties only.)

Crop Year	Pounds Sold "Free" Lbs.	Pounds Sold "Products" Lbs.	Pounds Sold Total Lbs.	Unsold Carry-out	Total Available Volume	Percent of Available Vol. Sold
1955-56	23.2	6.2	29.4	11.8	41.2	71.4%
1956-57	25.5	11.9	37.4	6.6	44.0	85.0%
1957-58	24.2	8.7	32.9	10.5	43.4	75.8%
1958-59 (Est.)	26.8	5.5	32.3	5.8	38.1	84.8%

Source: Date Administrative Committee

Table 4. Comparative Figures on Last Four Date Crops

Year Crop	August-December Sales of "Free" dates only. (Millions) Lbs. Sold	% Sold (a)	Gross F.O.B. Value total Date Crop (b) (Av. per Lb.)	Grower Return Marketable Dates (c) (Av. per Lb.)
1955-56	14.7	63.4%	12.7¢	6½¢
1956-57	17.7	69.4%	14.1¢	6¾¢
1957-58	16.2	66.9%	12.2¢	7¢
1958-59	19.7	73.5%	15.2¢*	7¢

*Estimated 1958-59 final return figures

(a) Percent of total "Free" date poundage sold between Aug. 1 and Dec. 31.

(b) Average FOB value per pound on all varieties & grades, cull & substandard included.

(c) Average grower return on all marketable Deglet Noor, Khadrawy & Zahidi grades.

Source: Col. 1 & 2 from Date Administrative Committee.

Col. 3 Gross FOB per pound caluculated from data secured from Riverside Agricultural Commissioner and set forth in Table 2 herein.

Col. 4 Grower Return figures furnished by Valley Date Gardens as industry wide averages.

all evidence bears out the claim that this is a Farm Program that is working to the advantage of the farmers.

There is no clear indication that time of sale had a material effect upon final grower returns. Table 4 would indicate that the percent sold in the August-December period could be a factor. More important is the quality of fruit, as indicated by the fact that the 1956-57 crop was of high quality with the smallest percentage of culls recorded in recent years.

An effort was made to secure independent opinion as to the major factors having direct effect upon price levels and grower returns. Agreement was found that:

1. Volume fluctuation or volume diminution, on the scale forecast herein for the next ten years, will not be a major factor. The volume of dates imported will have greater effect, particularly as to the price and demand for "Products Dates."

2. Strengthening of "Products" outlets and expansion of this program is vital.

3. Over all quality of dates produced is of major importance. Specifically, ranch operation should be such as to produce crops containing a minimum of 75% of dates suitable for general distribution as whole dates. This quality was defined as "Dates that will give consumer satisfaction."

4. Stable, competent marketing and orderly distribution. A minimum of each crop being marketed by shippers who are under strong pressure to turn inventory into cash without regard to price. An adequately financed growing and packing industry is implied.

5. Greater mechanization and increased efficiency in all phases of the industry.

Those responsible for the marketing of dates indicated remarkable unanimity in the firm conviction that grower returns could be increased sufficiently to assure the grower of a quality crop a return of twelve cents per marketable pound. It must be added that no packer offered to sign a contract agreeing to make such a return.

To summarize opinions secured: It appears that agreement exists that, given sound and effective marketing, continued effective operation of the Marketing Order, expansion of "Products" distribution, and reasonable improvement in field run quality and yield per acre, it is quite possible to secure a net profit of three hundred dollars per acre for a competent grower producing Deglet Noor, Khadrawy or Zahidi dates.

The future of the Date Industry is dependent upon a conviction that these conditions will be met. This conviction must be positive enough to stimulate planting of date acreage in volume. It is left to the reader to study the facts and reach his own conclusion as to the probability of significant acreage being planted during the next ten years.

A PANEL DISCUSSION OF CURRENT GROWER PROBLEMS

Moderator: E. J. Codekas (Date Grower)

Panel Members: Walter Geissler (Field Superintendent, California Date Growers Association); D. H. Mitchell (Date Grower); T. R. Brown (Date Grower)

The Date Industry has matured to the point where grower problems are again more important to the grower than marketing problems. The marketing situation has been relatively stable during the past two years and growers are now more concerned with actual field problems rather than marketing problems. This is as it should be and reflects a healthier, more stable industry.

The cool, wet spring this past season affected the date pollination very markedly. Some gardens had almost a normal pollination while others suffered losses of over 50% in unpollinated fruit. The panel will discuss this season's pollination and compare it with other years.

As our palms grow older and taller a greater percentage fall over, some because of high winds and others for no apparent reason. The panel will attempt to give some of the reasons for this.

The Medjool date has been the variety in which the most interest has been shown both by growers and also by buyers of fancy dates during the past few years. The panel will emphasize some of the hazards in handling the Medjool variety. We hope that both the grower and packer will benefit from this discussion.

WALTER GEISSLER

(Pollination Problems Last Spring).

Poor pollination very seriously affected last year's crop. From the middle of February to the 1st of March we had no rain and very little wind. From March 6 to 16 we had a very severe cold spell, 11 days in length, during which there were also 4 days of rain. The maximum temperatures during the 11-day period were from 63° to 74° F., an average of 68.6° F. From the 17th of March to the end of March the weather was warm with very little wind. However, we did have rain every 5 or 6 days. In the first part of April we had a 4-day cold spell. Maximum temperatures at the time were about 68° to 70° F. The weather got much warmer toward the end of April, and from the 18th to the 23rd there were 5 days of temperatures well over 100°, two over 109°.

Pollination started about February 15, but was slowed down by the cold spell of March 6-16, during which period most blooms failed to set fruit. We used liquor bags during that time, however. I believe that if we hadn't used them we might

not have gotten a set at all. The set from pollinations in February was better than that from the pollinations during the cold weather of March. The most seriously affected area was west of Indio, Indian Wells to Palm Desert, Rancho Mirage and Cathedral City. The reason for that was that the blooms were out already and usually the heaviest part of pollination in that area is done during the last part of February and the 1st of March. One grower in that area did not use liquor bags at all during the season; he only had about a 40% crop.

Another problem last season was fruitstalk breakage. This added considerably to the reduction of the crop. Again, the problem was mainly in the Rancho Mirage area. Bunches came out early and grew rapidly during February when the weather was warm. During the damp, cold spell stems continued to grow out but they weren't toughened enough from the warm weather and broke off. One tree lost 10 bunches in that way.

E. J. Codekas asked Mr. Nixon if the breakage of fruitstalks was not caused by bacterial rot.

Roy Nixon: I don't believe any pathological examination has ever been made, but I am inclined to think the trouble was not due to bacteria. Length growth of leaves and fruitstalks occurs at night and there is more of it during cloudy weather because elongation is inhibited by sunlight. During dry, sunny days the growth that occurs at night tends to harden during the day. What appears to have happened is that during the damp, cloudy periods that occurred last spring, fruitstalks made excessive growth which failed to harden and resulted in considerable bending and breaking of fruitstalks throughout Coachella Valley. I noticed during the rainy periods that water collected in the spathes around the base of some of the fruitstalks and remained there for several days.

E. J. Codekas commented that as long as maximum temperatures are 75 or 80° F. and up it is unnecessary to put bags over the flower clusters during pollination.

The question was raised as to whether it is good practice in pollination to break open the spathes before they open naturally. Several growers reported that they had done this with satisfactory results.

D. H. MITCHELL

(Why Do Palms Fall Down?)

The twenty acre block of palms farthest to the south at the Coachella Valley Fruit Co., corner of Ave. 50 and Calhoun Street in the Coachella Valley, has suffered a loss of close to ten percent.

Some of the palms were taken out purposely, two were killed by lightning, but most of them simply fell down. This is a serious economic loss since it is impractical to replant when the vacant spot is shaded by tall palms.

These palms range in age from 35 to 45 years and all are interplanted with citrus trees. They are of the Deglet Noor variety and of better than average vigor.

The total down would have been larger if a policy of propping a palm observed leaning had not been adopted. A palm that has been aided by propping seems to be happy about it and continues to bear normal heavy crops. On the other hand, there are a considerable number of leaning palms that have no props and have been in that state of defiance of gravity for years with no ill effects. It is only when a formerly upright palm develops a tilt that a hurried call for a prop is made, frequently too late.

At the Coachella Valley Fruit Co. the following observations have been made: 1—The palm is broken off at the ground level. 2—It falls almost invariably to the south along the path taken by the irrigation water. 3—While the diameter of the trunk at ground level may be 30 inches, the area of live tissue may be as little as 8 or 9 inches in diameter. The surrounding tissue, to a grower, does not look like healthy, functioning fibers. 4—As might be expected, most of the palms drop when carrying a heavy load of fruit. 5—Wind storms do bring downfalls, but some occur on calm days.

Falling down is not the exclusive privilege of tall palms. Just recently a palm with a trunk less than ten feet in height was observed in another date garden, and two others with trunks not over fifteen feet in still a third date garden. All had the same restricted area of tissue in the center that appeared to be functioning.

The question has been raised, "Is the downfall due to the possible damage to the trunk in early years when offshoots were cut?" The answer is probably negative since the "live" tissue is always circular. If offshoot cutting had been at fault the probabilities are that the shape of the area of good tissue would have been irregular.

In an effort to reduce the number of fallen palms C. V. Fruit Co. has surrounded the base of a large number of palms with a pyramid of soil. This program was not entirely successful as a few went down regardless, but quite possibly not as many as might have done so.

It would be helpful if at next year's Date Institute we could have the benefit of the observation of our Agricultural Scientists and such of our growers as are having the same difficulty.

J. R. Furr remarked that if, in a garden where tall palms had fallen from time to time, the soil was allowed to dry out, no more palms appeared to fall until irrigation was started again.

Roy Nixon stated that most of the fallen palms that he had seen were in gardens where water was in contact with the base of the palms over a considerable period of time. Under these conditions a thick mass of secondary roots develops around the base of the trunk and forms a collar, sometimes so tight and hard that it restricts movement of the trunk at that point and this may be one cause of breakage. The palm trunk increases in diameter until the maximum size and number of leaves is reached, but no increase occurs below the green leaves. The small area of live trunk tissue at the soil level may be due to the fact that a small offshoot was planted. Larger offshoots or nursery palms planted somewhat deeper than has been customery would help to avoid this weakness.

William Cook reported that he used to have trouble with palms falling down but not one had fallen since 1952 when he mounded up the soil around them and put guy wires on the leaning ones. Also he said that in a two-acre block of his oldest trees, formerly irrigated in furrows, a number of palms fell until he put in high permanent borders in the palm rows and since then no more have fallen.

THOMAS R. BROWN

(*Handling of Medjool Dates for Marketing*)

The plantings of dates of the Medjool variety from the eleven offshoots introduced in 1927 by Dr. Walter T. Swingle are sufficient to produce, when mature, approximately a half million pounds of fruit. I have been asked by the program committee to discuss the problems we have encountered in preparing this type of date for the market.

Some of the characteristics of the Medjool date might first be observed.

1. Size. The Medjool is the most responsive to thinning practices of any date I know. If the bunches are reduced on a mature palm to fifteen and the strands reduced to thirty or less and then strand thinned to fifteen or sixteen dates per strand, the grower can expect to harvest dates ranging in size from twelve to thirty to the pound. A well fertilized and

watered mature palm will produce 200 to 225 pounds per year.

2. Moisture content. The Medjool date is a semi-soft date with a high moisture content. We have observed that trees in light, sandy soil produce drier fruit than those in heavier soil. Moisture content of fruit after six months storage at zero ranged from 31 to 24%.

3. Keeping quality. The moisture content of the Medjool date determines its keeping quality in storage. Moist dates stored at 38° Fahrenheit begin sugaring after three months storage, or six months at 0°. Drier fruit seems to keep without developing sugar crystals for a much longer time. If fruit is too moist it will sometimes sour even in cold storage.

4. Insect damage. The Medjool date matures early in September while a good supply of date beetles are flying. The fruit has a large calyx opening and beetles have no trouble entering the fruit. The Bard area seems free of beetles, and according to Mr. Stanley Dillman, no troubles are experienced there. Here we feel that a dusting with Malathion as the first fruit softens is necessary to keep down infestation. Washing the fruit after picking has been necessary to remove insecticides and dust.

5. Shattering at picking time. The Medjool date shatters easily when strands are moved as pickers work. Unripe fruit and ripened fruit falls easily and a clean canvas or a picking loop under the bunch is necessary. A box of fruit contains several stages of ripeness when it reaches the packing house.

The size of the Medjool date, the moisture content, and the necessity of washing the ripened fruit complicates the problem of preparation for market. We have found from experience, that in traying the fruit for washing, the fruit not fully ripened should be separated and cured thoroughly before grading. We first fumigate all the fruit, separate the green from ripe, wash the trayed fruit with a fog spray, remove excess water with compressed air, then stack the trays in a warm room until dried before running it over towels on a shaker. The dividers are removed on the grading belt to prevent bruising or mashing of the fruit. The skin on fruit not fully ripe is tender and easily damaged by handling.

The cleaning and grading methods in large packing houses geared for volume production are not suited to Medjool dates. If the volume of dates from acreage planted is to reach the consumer in good condition, special consideration will have to be given it in packing. This date is a specialty product in great demand if properly prepared. Our mail order customers report that there is nothing they can send from California that meets with such enthusiastic response. It would seem to have great possibilities if grown properly and packed carefully.

R. S. Dillman said that the bags he used to cover his Medjool bunches had a section of cheesecloth (32 threads to the inch) which extended below the bunch and was kept tied. This not only prevented beetles from getting into the bunch but caught all the dropped fruit which was enough to pay for the covers.

E. J. Codekas reminded growers that the Medjool date goes into fancy trade which justifies more labor and expense in handling.

William Cook called attention to the need for frequent picking of the Medjool date in order to avoid loss.

Mrs. Edna Cast urged growers not to pick and send to the packing house Medjool dates that are very moist. The fruit cures better on the palm than it does in the packing house. Considerable trouble was reported in trying to handle and ship Medjool fruit with a moisture content too high. Such fruit is likely to spoil before it reaches the consumer and this will give the variety a bad name.

R. S. Dillman reported that he stacked his moist Medjool dates on trays where they were exposed to warm air blown by a fan and that it didn't take long to dry them.

"SAMPLING OF SOME DATE PRODUCTS"

By Hillman Yowell

California Date Growers' Association, Indio, California

For the last part of the program the meeting adjourned to the school cafeteria nearby. There members of the Date Institute were guests of the California Date Growers' Association who served coffee and invited all present to sample, as well as inspect, a large assortment of date products displayed for the occasion. Mr. Yowell, plant manager of "Caldate," explained that the attractive array of various cakes, cookies, stuffed dates, etc., were all the results of a research program that is being conducted by his organization to originate new and better food products in which dates are a major ingredient.

Date Growers' Institute - 1959 Membership

(As of September 12, 1959)

Arkell Date Gardens . . . . . Indio
Asker, Earl H. . . . . Indio

Blackburn, R. W. & Sons . . . . . Thermal
Brown, Thomas R. . . . . Thermal
Burnham, Roderick . . . . . Palm Springs

California Date Growers Association . Indio
Carlson, Ted . . . . . Pakistan
Cast, Edna . . . . . Mecca
Cavanagh, H. L. . . . . Palm Desert
Citrus Experiment Station Library . Riverside
Claydon, John T . . . . . Indio
Coachella Valley Publishing Co. . . . Indio
Coachella Ranches . . . . . Riverside
Codekas, Jerry . . . . . Thermal
Cook, R. E. . . . . Indio
Cook, W. W. . . . . .Palm Desert
Cosgrove, Robert . . . . . Indio
Crommelin, Mrs. J. B. . . . . Palm Springs
Cruess, W. V. . . . . Berkeley
Culbertson, John T., Jr. . . . . Indio

Darley, Ellis . . . . . Riverside
Dates Officer . . . Berbera, Somaliland Prot.
Dillman, R. S. . . . . Winterhaven
Downing, A. P. . . . . Brewton, Alabama

Echols Ranch . . . . . Thermal
El Fawal, Ahmed Naguib . Damarhoor, Egypt
Embleton, Tom W. . . . . Riverside

Falk, Rosalie . . . . . Milwaukee, Wisc.
Farrar, E. Keith . . . . . Indio
Furr, J. R. . . . . Indio

Gandra, Sidney O. . . . Sao Paulo, Brazil

Hilgeman, Robert H. . . . Tempe, Arizona
Hopland, A. N. . . . . Thermal
Hughes, Larry . . . . . Los Angeles

Jarvis, Eugene . . . . . Thermal
Jenkins, Paul . . . . . Indio
Johnson, Mrs. May . . . . . Winterhaven

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Laflin, Ben, Sr. . . . . Thermal

Leach, George . . . . . Thermal
Lichty, Kenneth . . . . . Indio
Lindgren, David L. . . . . Riverside
Lippincott, Gardner . . . . . Palm Desert

Martin, Mrs. Ray . . . . . Rancho Mirage
McCurdy, Mrs. Ralph B. . . . . Pasadena
McCurdy, Richard C. . . . . New York
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Nixon, Roy . . . . . Indio

Patterson, Kenneth . . . . . Coachella
Peightal, B. J. . . . . Indio
Pinyan, R. A. . . . . Indio
Pryor, Mrs. Anna K. . . . . Los Angeles
Puls, J. H. . . . . Santa Monica

Reid, Robert H. . . . . Chicago
Reuther, Walter . . . . . Riverside
Richardson, H. B. . . . . Davis
Riverside Co. Agri. Comm. . . . Riverside
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Schroeder, C. A. . . . . Los Angeles
Schwartzburd, Martin . . . . Los Angeles
Shields Date Garden . . . . . Indio
Sunipalms Date Garden . . . . . Indio
Swingle, Leonhardt . . . . . Indio
Swingle, Mrs. Walter T. . . . San Francisco

Turk, Howard . . . . . Coachella

Venus Foods . . . . . Los Angeles

Webb, Robert W. . . . . Palm Desert
Weiss, Benjamin . . . . . New York
Westerfield, John W. . . . . Coachella
Western Province Fruit Research Director
. . . . . Stellenbosch, South Africa
Wise, George . . . . . Mecca

Yost, Leland . . . . . Thermal
Yowell, Hillman . . . . . Indio

Zait, M. . . . . Kfar Rupin, Israel

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